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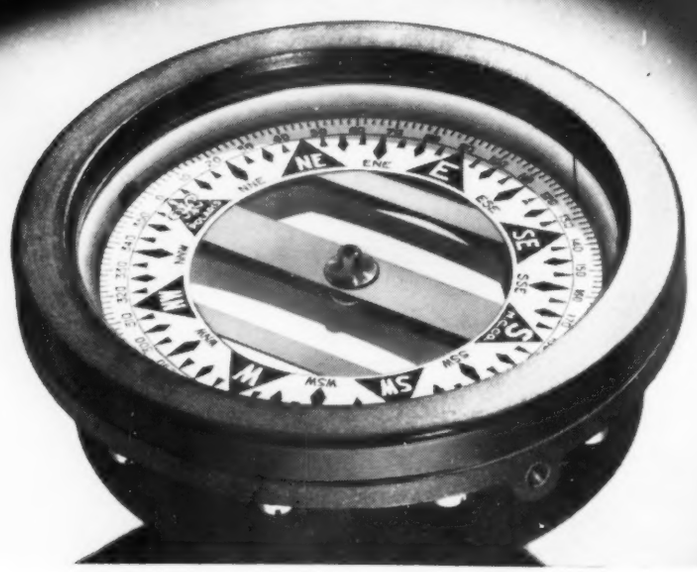

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The Armed Forces Chemical Journal is the official publication of the Armed Forces Chemical Association. The fact that an article appears in its columns does not indicate the approval of the views expressed in it by any group or any individual other than the author. It is our policy to print articles on subjects of interest in order to stimulate thought and promote discussion; this regardless of the fact that some or all of the opinions advanced may be at variance with those held by the Armed Forces Chemical Association, National Officers, and the Editors.

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COVER PHOTO

Snow and chow-time didn't stop the 87th from answering a "fire-support" call See Story on page 17.

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AN OPEN LETTER TO THE MEMBERS OF THE A. F. C. A.

This is a Call. A call to each of us. A call to thought, to loyalty and to action.

The great question to the researcher is "Why?" The great question to the man of action is "Why Not?".

Why are we not a large, sure, clear-visioned and effective organization?

We have within our body strength and potential equal to that of any Service Club or Association. Our Directory is an Honor Roll of men who have fought and won ever since they were old enough to think a thought, plan a plan, and deliver a punch. To this you must agree: we take second place to no Association in our individual quality and ability.

So I put it to you—why do you ante your five dollars every year and attend few meetings? Why do you ante your five dollars every year and never talk up the A.F.C.A. to your friends and associates? Why do you ante your five dollars every year?

I'll tell you what I think. I think that you pay the five dollars because you *want* an A.F.C.A., because you believe in the idea of an A.F.C.A., because your conscience and your loyalty won't let you believe that the A.F.C.A. isn't a "right" idea, a "true" ideal and an organization to which you *want* to dedicate a part of yourself. I think that you don't talk up the Association and that you don't attend meetings for one and the same reason—that you can't quite put into words the things that you feel about the A.F.C.A.—that you are a little ashamed to realize that Article II of our Constitution doesn't say what you want it to say, is too impersonal and gives you no Flag to fly at your Masthead.

Many times in these past two years I have asked the question of members of the A.F.C.A., "What do we have to offer the Individual?" In every case the answer has been unsatisfactory, incomplete, almost incoherent. Yet all of the men I approached with this question are devoted to our organization and have given greatly of their time, money and effort to its service.

It is high time we put into clear, unvarnished words our credo, our faith, and proudly acknowledged it before the world and to each other. That is what we have to offer. This is our pride and our will. This is our dedication.

Our passion is for our country's welfare.

Our faith is in Chemistry.

Our mission is to further the use of Chemistry in our National Military Security Program.

Our opportunity is to serve.

With this as a song in our hearts, with faith in the ultimate destiny of America as the working Symbol on earth of God's gift of Freedom to Man, we will forge our Association into an organization worthy of ourselves and of that faith.

So let us breathe new life and vigor into the A.F.C.A. Let us attend meetings. Let us work hard. Let us become strong through new memberships, new blood and new courage. Let us walk with God with our heads held high; let us strike a fair blow, and let us deliver it with all our might.

NATHANIEL S. PRIME
Rear Adm. U.S.N., (Ret.)
1st Vice President, A.F.C.A.

The Annual Meeting

The Eighth Annual Meeting of the Armed Forces Chemical Association will be held on Wednesday and Thursday, May 20th and 21st, 1953, at the Waldorf-Astoria Hotel in New York.

The general schedule for the meeting is as follows:

Wednesday—Directors Meeting
Annual Report of the President
Social Hour

Thursday—Speaker Session
Social Hour
Banquet

Arrangements are now in progress for all of these events, and it is certain that we shall again be able to obtain eminent speakers on subjects of timely interest.

Our 1953 meeting is timed for mid-week to permit a larger attendance from the New York area; while simultaneously accommodating out-of-towners so that they may more conveniently extend their stay in New York if they so desire. We have canvassed a number of the Chapters and have been advisd that we will probably in this way realize the large turnout which we hope will eventuate.

The manifold interesting activities of the New York area scarcely need build-up by your Committee nevertheless, the gamut extends from the theater to the United Nations and our meeting schedule has been devised to permit as much free time as possible for full enjoyment of the locale while still accomplishing the purposes of our organization.

Reserve May 20-21 for A.F.C.A. and we promise you the best Annual Meeting in our venerable line of eight.

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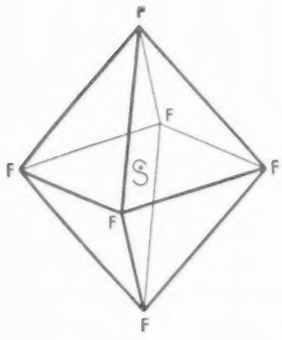

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NEW TECHNICAL BULLETIN available: To assist research and development engineers in evaluating Sulfur Hexafluoride, General Chemical has prepared a new Technical Bulletin No. SF_6A, containing selected data on the physical properties of Sulfur Hexafluoride. Free copies are available on request; please use business letterhead when writing.

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View of entrance to the Main Headquarters Building, Pine Bluff Arsenal.

—U.S. Army Photo

Rail traffic is essential to a manufacturing arsenal like Rocky Mountain.

A "NEW LOOK" IN M

By MAJOR GENERAL E. F. BULLENE
Chief Chemical Officer, Dept. of Army

Today we are in the midst of highly expensive preparations against potential enemies whose basic aim could be to bankrupt our economy through the sheer weight of this expense. In this near-dilemma, waste and inefficiency assume the importance of evil "giants," and the Army Chemical Corps has stepped into a role of "giant-killer." The Corps has been testing a plan which proves to be a real aid to efficiency and flexibility in the management of men, money and materials. It can bring imagination and ingenuity into play in stretching our tax dollars.

Although the plan was not originated in the Chemical Corps, the Corps can justly feel proud of the initiative and resourcefulness which have been required to transform its theory into actual practice. Deserving of special mention on this score are Brig. Gen. H. H. Black, Commanding General of the Corps' Materiel Command; Col. Crawford M. Kellogg, formerly Commanding Officer of our Rocky Mountain Arsenal, and many others, including the entire staffs of these units.

This specialized management device is known as the Army Industrial Fund (or revolving-type fund) system. It has cleared the hurdle of a one-year test with good results and recently received official sanction. The test was held at Rocky Mountain Arsenal, where the system is still in use. This station has since become the point upon which most eyes of the Army are fixed for guidance in terms of experience gained toward implementation of an Army-wide program which ultimately contemplates bringing about 54 major installations under this means of management.

Meanwhile, the plan has been installed at our Pine Bluff Arsenal and Lt. Col. John J. Hayes, former Chemical Corps Comptroller and one of the sparkplugs in the initiation of this program, has been transferred to that station as its Commanding Officer. It is now proposed that the system be put to use at several other Chemical facilities.

A brief explanation of the theory of this plan is that Pine Bluff and Rocky Mountain Arsenals have been "put into business" with a fixed amount of working capital. Thereafter, all goods and services they produce are strictly on a buyer-seller relationship with their "customers"—the Army, Navy, Air Force and other government agencies. This has the effect of putting a dollar value on every phase of operation and each action taken. Thus, from a quick glance at the records, areas of mismanagement, as well as clues to their remedy, are clearly and quickly highlighted.

Rocky Mountain was picked as a test station for development of this concept because, in contrast to the traditional type military post, it is almost entirely an industrial facility. It was built in 1942 on a 22,000 acre tract about 12 miles northeast of Denver, Colorado. During World War II, it produced chlorine and certain incendiary munitions, and was afterward placed on a standby status. It was only partially reopened at the outset of the Korean situation.

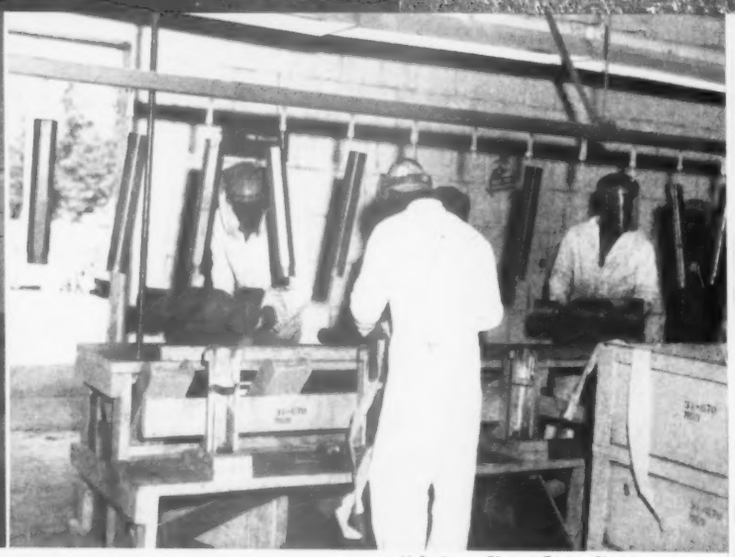
Pine Bluff Arsenal, the second of the Corps' industrial facilities to be brought under this program, was also built in World War II and produced some of the incendiary bombs used by U. S. and its Allies. Currently, two of this Arkansas station's main projects are filling white phosphorus shells and refilling certain types of unused World War II bomb clusters.

Both arsenals are typical of the many factory-type installations operated by the various armed services to produce munitions and render certain miscellaneous services for all branches of the Defense Department. The individual Defense agencies buy and sell, to each other, the output of their respective industrial plants. Payment, as in most commercial transactions, is made on a unit cost basis.

This unit cost, or the customer's price, probably best illustrates the major difference between the Industrial Fund financing plan and the old appropriation type, commonly used by other government agencies today. In the case of an arsenal, for example, its expenses under the old system would be paid from several different appropriations, sometimes running into the dozens. As the books on these appropriations were kept separately, in many cases at widely separated geographical points, it all boiled down to the fact that these arsenals were using money from several different bank accounts, without coordinated control. Accordingly, an accurate reckoning of the entire cost of a given item of arsenal production was impossible, and in fact was never attempted, except on a statistical basis. Because of this separation of cost figures, customer prices were based on comparatively crude estimates.

—U.S. Army Photo

Hundred of vehicles bearing employes of Rocky Mountain Arsenal pass through these gates daily. The huge 19,000 acre installation has over 1,500 employed from the Denver metropolitan area.



—U.S. Army Signal Corps Photo

Workers on the M-19 Incendiary Bomb Line at Pine Bluff Arsenal doing refurbishing work on the M-69.

IN MILITARY PRODUCTION

In contrast to this separation, the new system uses a single fund—from which all production expenses are paid. This enables the accumulation of costs at a single point of control, and customer prices can then be calculated rather accurately. Payments from customers flow back into this same fund reservoir, hence the term "revolving." The regulations require that this revolving fund be maintained at the same constant level, and this rule operates to insure that customer prices include all actual production costs incurred.

It necessarily follows that the arsenal management is thereby afforded a complete and accurate set of figures on the dollars spent for each purpose, and these can be readily matched against production data. At Rocky Mountain, for example, a monthly operating statement of this type is prepared for each level of management, beginning with the shop foremen and supervisors. Each of these men thereby obtains a clear and accurate statement of the cost of activities of his particular shop for the preceding month. This complete picture of operations can be used as a basis for the immediate recognition of deficiencies and the initiation of prompt corrective actions for the more economical use of men, money, and materials. It also promotes an acute cost-consciousness, which permeates all ranks.

Procedures have been adopted to assure that these figures will accurately reflect the cost of all labor and materials used both directly and indirectly on each job. For example, the cost of all tools and equipment having a normal life of less than one year, as well as special machinery acquired specifically for a given project, are financed from the revolving fund and repaid by customers. The same is true of repairs of active plant and equipment.

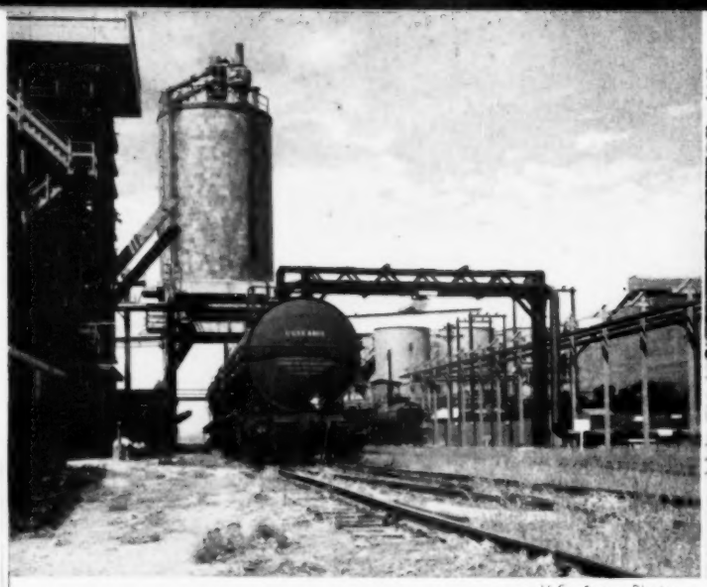
Materials and supplies used from inventories are charged in the end item price in accordance with a method known and accepted in private industry as the "weighted average." Civilian labor and salaries are charged to production at actual cost, and charges for direct labor are priced to include overtime and provisions for annual and sick leave. Indirect labor (administrative and the like) is treated as an overhead cost and is equitably distributed to the production centers.

The Medical Department at Rocky Mountain affords an illustration of the way the costs of indirect support activities are brought into the picture. The dispensaries operated by this Department are equipped to provide complete industrial medical services. These have been made available to lessees, satellite and military personnel at an established rate per treatment. After deduction of the direct charges to these accounts, the remainder is charged to the production centers, each center receiving a portion based on the number of workers it employs. In this way, the Arsenal's medical bill does not become a hidden, and hence irrecoverable drain on the revolving fund.

All these detailed arrangements for an accurate recording of labor, materials, and support costs simply make it possible to add up an accurate price for the customer. This price must exactly replace arsenal expenditures, for the regulations do not permit the revolving fund to show a profit or loss. But this same price also includes practically all items of expense over which the local management can reasonably be expected to exercise any restraining or directing influence; these same cost items are variables which can be converted to reliable yardsticks of performance. The figures, in the form of the monthly operating statement, become a mirror into which arsenal bosses can direct long and searching looks to detect errors and possible approaches to improvements.

Regarding these charges to customers, one note of caution is required at this point: Arsenal prices are comparable to those of private industry only in a certain limited sense. Rocky Mountain's physical plant cost about $65,000,000 when it was built and Pine Bluff's about $60,000,000—and no plant depreciation is included in the bill for finished goods. Nor are major replacements and additions of property, military pay and allowances, injuries and damages paid through the U. S. Employees Compensation Commission, the share of the Government's contribution to the Civil Service Retirement System or maintenance of idle facilities. On this subject, the Defense Department Regulations state:—

"All persons desiring to compare total costs of production in defense industrial—or commercial-type establishments with costs of similiar private establishments should be advised of the difficulty of full comparison of costs—although



—U.S. Army Photo

The might and majesty of the nation's industrial facilities is depicted in this photograph of Rocky Mountain Arsenal, a Chemical Corps manufacturing plant located near Denver, Colorado.

—U.S. Army Signal Corps Photo

View of the Guard House at Plainview Gate, the most heavily utilized entrance to Pine Bluff Arsenal.

a private establishment pays taxes, insurance, etc., where the Government pays none, the Department of Defense is engaged heavily in training and in the operation and maintenance of facilities and organizations under peacetime conditions for use in an emergency, which operations are not necessarily economic from a business viewpoint, and it is not possible in every case to identify all nonproductive costs."

Both Rocky Mountain and Pine Bluff Arsenals keep careful records on these excepted items (known technically as "statistical" costs) however, for it is planned that at least some of them will eventually be brought into the group to be paid from the revolving fund. Meanwhile, the money for most of these "statistical" costs comes from the congressional appropriations available for these specific purposes. Aside from these variations, these government installations operate under an accounting system which is very similiar to the type used in private industry.

The history of the development of this system begins with the Hoover Commission, established after World War II to study the possibilities of government reorganization. Based on a recommendation of this group, the 81st Congress enacted Section 405 of Public Law 216, which was signed by the President on August 10, 1949. This provision authorized the Secretary of Defense to establish working capital funds for industrial-type activities. To implement this legislation, Defense Department Regulations were published under date of 13 July 1950.

In May of 1951 a working group of Army Comptroller and Chemical Corps representatives made a visit to our Colorado installation to study the feasibility of putting these provisions into effect. This task force made a second trip a month later to draw up certain necessary documents; among these was a charter which authorized Rocky Mountain a working capital consisting of $9,000,000 in cash and miscellaneous supplies valued at $5,240,000. In July 1951, operations began on a test basis. (At approximately the same time, similar tests began within the Quartermaster and Ordnance Corps).

Meanwhile, in the two-month period following the first visit, this group had to deal with a multitude of problems never previously encountered. The effectivenes of their work was later reflected in a letter from Mr. Robert A. Lovett, then the Deputy Secretary of Defense, congratulating the Secretary of the Army on the successful progress of operations at the arsenal under these funding arrangements.

Now, after more than a year's operation at Rocky Mountain Arsenal, some of the effects of the system can be rather clearly seen. It has put the entire organization on its toes; there is a calculating and continuing effort toward greater effectiveness with less waste effort. All over the post there is evidence that the taxpayer is being saved plenty of hard cash.

The Air Force, for example, had expected to pay about $300 each for a certain order of bomb clusters. At the last count, however, the average cost for all production had been driven down to $288 per cluster and it was expected that the Air Force would save about $850,000 on this lot alone. For the first month of production, it actually cost the arsenal $315 to make each of these clusters, but when this figure was flashed on the monthly statement all hands knew that improvements had to be made. The cost went down to $310 and then to $299 as the workmen became more skilled; but the figure still continued downward as efficient management improved methods and equipment, eliminated some operations which study showed to be unnecessary, and reduced personnel where they were not required. This went on until one month showed an average of $271 per cluster and the end of this downward trend was not in sight.

The year's trial showed many other advantages for the plan. For one thing, the data in the monthly operating statements can be easily understood by shop foremen and supervisors, since they do not require a fiscal background for interpretation. After the first month of operation there were three instances in which supervisors had been demanding additional personnel to accomplish their workload. Upon study and analysis of the costs of operation of their particular activities, these supervisors cancelled their requests. Cases have since come to light in which whole departments were actually meeting or exceeding previous production averages with as few as 85 percent of the personnel formerly thought necessary.

A part of these manpower economies are due to the fact that this system facilitates the exchange of labor between different production lines. This exchange was seldom practiced under the appropriation type financing, due to the diversity of control and interests among the various departments. (In addition, considerable paperwork was required for a person being paid from Appropriation "A" to be moved to a project specified under Appropriation "B.") As with all other new devices, there have been occasions when the human element came to the fore on this subject. One supervisor, faced with a sudden rush order, went out to borrow workers from another, partially idle activity. Not until later did he find that the loaning department had sent its most expensive help, thus loading up his costs for the month with a figure way out of line with the work being done. Fortunately, however,

—U.S. Army Signal Corps Photo

Pine Bluff Arsenal White Phosphorous Filling Line. Basil Smith, Inspector at Pine Bluff, checks 4.2 mortar shells as they come out of the stencil and marking machine. At the left an operator brushes out the nose of the shell with a mechanical brusher.

—U.S. Army Photo

Canned and ready for delivery to the Army's fighting soldier wherever he may be are these White Phosphorous grenades in the last phase of their production on an assembly line of Rocky Mountain Arsenal. The manufacture of this and other munitions at the arsenal comes under the guiding surveillance of the Army Industrial Fund, which has been responsible for cutting down the cost to the public of making munitions like Chemical Corps Incendiary bombs and grenades.

practically no real friction has developed on this point, although there is a keen competitive spirit between the various departments.

In the opposite sense in fact, cooperation has become the watchword inside each production center, for every workman has the previous performance figures before him and knows his team must either equal or beat them. Further, the figures are significant to the average worker because they bear the dollar sign, a symbol which has motivated and controlled his whole life.

The program has also proved very gratifying to customers. This is because it provides the actual costs of each product and service furnished, thus giving a better basis for budgeting and programming for future orders. Where an additional order is placed for a product previously made by the arsenal, the simple formula of unit cost times the number of items desired (with provisions for variations in volume) will provide the required budget data. Further, the amount of work which can be performed for a specified dollar figure can be readily estimated on the basis of past experience. In the case of a new product which the arsenal has not previously made, an estimate can be built up, department by department, with considerably more speed and accuracy than was previously possible.

Ordering agencies are also given a greater sense of responsibility, as their requests must be limited to the specific amounts of money they are willing to spend. Further, they can balance the cost of such goods and services against the benefits and advantages of their use.

The year's trial brought out another good feature in the case of the inventory of maintenance and operating supplies. The previous reporting system only called for an enumeration of stock items without any really usable cross-reference as to their value. Under the new plan, the dollar sign became a common denominator for identification of values as well as quantities. In addition, the new records showed time of receipt and time of use. The latter factor soon revealed, among other things, that only about a third of this stock was showing any turnover. The supply men then began to look for ways to reduce the excess—and thereby cut storage and maintenance

(Continued on Page 53)

Top officials of Rocky Mountain Arsenal, Chemical Corps manufacturing installation near Denver, Colorado, are shown at a monthly "Board of Directors'" meeting conducted to analyze costs of producing grenades and incendiary bombs. Under the Army Industrial Fund, the Arsenal operates in the same manner as most commercial firms. Reading clockwise, the board members are Mr. George Donnelly, Chief, Maintenance Division; Maj. Edwin S. S. Hayes, who heads the Production Division; Colonel A. W. Meetze, Deputy Commander; Colonel C. M. Kellogg, Arsenal Commander; Lt. Colonel Donald P. Smith, Executive Officer; Mr. E. C. Thompson, Chief, Engineering Office, and Mr. John O'Hehir, Deputy Comptroller; Major John Moran, Comptroller, is standing.

—U.S. Army Photo

This photo depicts the Army Industrial Fund in operation at Pine Bluff Arsenal and was taken at a meeting of the "Board of Directors," consisting of the Commanding Officer, the Deputy Commander, the four Assistants, the Comptroller, the Chief Arsenal Engineer, and the Chief Inspector, discussing the question of costs which would be involved, prior to accepting an order proposed for Pine Bluff Arsenal. It depicts Cost Consciousness in operation, using the Army Industrial Fund and an essential management tool.

—U.S. Army Signal Corps Photo

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An Analysis of the President's Materials Policy Commission Report from the Standpoint of the Chemical Industry

By RAYMOND H. EWELL

Manager, Chemical Economics Service, Stanford Research Institute

In June 1952, the President's Materials Policy Commission issued a report "Resources for Freedom" which is destined to influence national policy for many years to come. The liberal use of materials has been one of the most important factors in the economic development of the United States. We have been the supreme advocates of the idea that man and his labor are the most valuable of commodities and that materials are to be used as fully as possible to save man's time and labor. Now this report warns us that we are nearing the end of cheap, readily available sources of many of our key raw materials. Therefore, we as a nation must give new and deep consideration to the fundamental upon which our national economy, our national defense, even life itself, eventually rests: the contents of the earth and its physical enviroment.

The President's Materials Policy Commission was created by President Truman on January 22, 1951 to make a broad, objective survey of the materials supply problem as a basis for decisions by the President and Congress. The members of the Commission were William S. Paley, Chairman, Arthur H. Bunker, George R. Brown, Eric Hodgins and Edward S. Mason. The President's letter authorizing the Commission expressed the hope that the Commission's report would be ready in the fall of 1951, but the task was so great that the report was not completed until June, 1952. The Commission had a temoprary staff of about 100 persons drawn on a loan basis from government and industry. In addition, many sections of the work were farmed out to organizations such as Arthur D. Little, Inc., Battelle Memorial Institute, and a number of industrial concerns. The report as issued comprises five volumes, totaling 819 pages, obtainable from the Superintendent of Documents at $6.25.

U. S. Demand for Materials Rising Rapidly

"Resources for Freedom" attempts to forecast the supply and demand for raw materials in the United States through 1975. The Commission made the basic assumptions that (1) past growth rates would be continued, (2) the population of the United States would be 193 million in 1975 (vs. 152 million in 1950), and (3) the gross national product would be $550 million in 1975 (in 1950 dollars vs. $280 million in 1950). Doubling the gross national product will require only 64% more raw materials excluding food (or 53% including food).

The reason for this apparent discrepancy is that we are continually applying a higher degree of fabrication or a higher value added by manufacture to the raw materials consumed. However, even increasing non-food raw materials by 64% by 1975 will require utilization of lower-grade domestic sources and also importing greater quantities of raw materials than heretofore. Figure 1 indicates graphically how the United States is outgrowing its domestic resource base. Figure 2 shows the expected increase in a number of key raw materials in 1975 compared with the growth of population and gross national product.

The basic conclusion of the PMPC Report is that many of our important raw materials are going to get scarcer and/or more costly during the next twenty-five years. Population, gross national product, and raw materials consumption per capita are all increasing exponentially. At the same time, our basic supplies of raw materials are certainly not increasing. Our production of some raw materials may be increasing, but our basic supplies of raw materials in the earth are static at best. The economy of the United States has always been based on plentiful supplies of raw materials, but we are now moving from an era of plentiful raw materials into an era of raw material deficits. For example, during the last ten years, the United States changed from being a net exporter to being a net importer of copper, lead, zinc, iron ore, petroleum, and lumber. Among all the metals, we are self-sufficient today only in two: magnesium and molybdenum. The decade of the 1940's was an important turning point in the raw material supply position of the United States. This is quite clear from the statistics even at the present time, but it will become increasingly apparent during the next twenty-five years.

Increasing Costs of Raw Materials

Our supplies of raw materials are not going to be cut off sharply at any particular time in the future. Rather, gradually increasing prices will reflect the necessity of using lower-grade sources. The United States has a history of reducing the "real" cost of raw materials, expressed in terms of labor and capital investment required. However, we may now be

Biography

RAYMOND H. EWELL

Raymond H. Ewell was born June 18, 1908 in Brockton, Massachusetts and spent his early years in Massachussetts, Indiana, and Ohio. He received his B.S. degree from the University of Toledo in 1928 and completed his M.S. degree at Purdue University in 1930. From 1930 to 1935 he was a research chemist in the Ceramics Division of the National Bureau of Standards in Washington, D. C. In 1935 he returned to graduate school at Princeton University where he received his Ph.D. degree in 1937.

In September 1937 Dr. Ewell returned to Purdue University as assistant professor of physical chemistry. In December 1941 he was called to Washington to become connected with the National Defense Research Committee as senior technical aide in the Chemical Engineering Division. In his N. D. R. C. post Dr. Ewell played a key role in the development of incendiary bombs and flame throwers used in the war. In addition to the development phase of this work, he was also closely associated with the planning and analysis of the incendiary bomb attacks on Japan. He received the highest civilian award, the Medal of Merit, for his war work.

Following the conclusion of the war in 1945, Dr. Ewell joined the Shell Chemical Corporation in San Francisco as senior chemical economist in the Economic Research Department.

In 1948 Dr. Ewell joined the Stanford Research Institute, first as chairman of chemistry and chemical engineering research, and later as manager of the Institute's Chemical Economics Service. In his present position Dr. Ewell supervises a group of chemists, economists and statisticians engaged in publishing the Chemical Economics Handbook, and in conducting economic surveys for the chemical, petroleum, and allied process industries.

Dr. Ewell's researches and numerous publications have been in the fields of chemistry of silicates, viscosity of liquids, applied chemical thermodynamics, azeotropic distillation, and chemical economics. He is co-inventor of the Lecky-Ewell packing for fractionating columns. Dr. Ewell is a member of the American Chemical Society, American Institute of Chemical Engineers, Society of Rheology, Sigma Xi, Phi Lambda Upsilon, Sigma Pi Sigma, Western Chemical Market Research Association, Commercial Chemical Development Association, and American Economics Association.

As an interesting hobby Dr. Ewell is a gourmet and wine connoisseur of some note. He is author of the well-known guide book, "Dining Out in San Francisco," is a member of the Wine and Food Society of San Francisco, and is a judge of wines for the California State Fair.

at a point when "real" cost of production of raw materials will increase. This will, of course, have the effect of slowing down the rate of increase in our standard of living. Figure 3 illustrates how many raw materials have higher "real" prices now than they did 10 years or 50 years ago, despite great advances in technology. Chemicals have an outstanding record in decreasing "real" prices.

Important Roles of Plastics and Light Metals

Among the most important impending shortages are copper, lead, zinc and tin. The PMPC Report puts particular emphasis on the importance of plastics, aluminum and magnesium as replacements for copper, lead, zinc and tin. Figure 4 shows how plastics and light metals have advanced from 17% of the combined market for plastics and non-ferrous metals in 1920 to 72% of the combined market in 1949. Plastics, aluminum and magnesium are all based on virtually inexhaustible raw materials. When one examines the markets for copper, lead, zinc and tin, it is apparent that plastics, aluminum and magnesium can replace a large proportion of the markets for these metals. They can also replace many of the markets for steel, cast-iron and wood. Plastics, in addition, are replacing glass, ceramics, leather, rubber and textiles. The PMPC Report repeatedly refers to "the ubiquitous plastics"—which are destined to become even more ubiquitous.

Six Tasks for Technology

After a detailed comparison of the probable demand and supply of our key raw materials, the report concludes that the hope of the future lies in research and improved technology. The report outlines six tasks for technology, as follows:

1. To develop new techniques for discovery of raw materials, particularly minerals.
2. To bring new materials into use, and old materials into new uses.
3. To develop more effective recycling of non-renewable materials.
4. To develop techniques for using lower-grade sources.
5. To substitute renewable materials from plant and animal sources for non-renewable mineral products.
6. To substitute abundant materials for scarce ones, e.g. aluminum for copper.

Obviously, chemistry and chemical engineering are the principal keys to solving numbers 2 to 6, and also enter into number 1 to a large extent.

Chemicals in the PMPC Report

The big bulk of the PMPC Report is concerned with metals, minerals, mineral fuels, and energy. Smaller sections of the report deal with chemicals, forest resources, agriculture and soil resources, water supplies, and ocean resources. The scope of the report is so vast that it cannot possibly be critically reviewed in the space available for this article. Therefore, the remainder of this article will consider only the portions of the report of particular interest to the chemical industry.

Material relating to chemicals is widely distributed throughout Volumes II and IV, but the following are the principal chapters of the report dealing primarily with chemicals:

Volume II

Chapter 17—Sulfur, By PMPC staff
Chapter 18—Fluorspar, By PMPC staff
Chapter 20—Rubber, By PMPC staff
Chapter 21—Chemicals, By PMPC staff

Volume IV

Chapter 9—Technology of Ocean Resources, by Iver Igelsrud, Battelle Memorial Institute

Chapter 12—Coal Products and Chemicals, by Koppers Company group

Chapter 13—Oil and Gas as Industrial Raw Materials, by Gustav Egloff, Universal Oil Products Company

Chapter 14—Forecasts for Petroleum Chemicals, by Standard Oil Development Company group

These chapters total 83 pages, or about 10% of the total Report.

The situation with respect to the raw materials of the chemical industry may be summarized as follows:

Sulfur, Fluorspar	Increasing scarcity
Salt, Limestone, Phosphate rock, Potash, Brines, Sand	Plenty
Coal, Petroleum, Natural gas	Primarily used for fuel; plenty for use as chemical raw material.
Wood, Fats and oils	Renewable; plenty for use as chemical raw material.

Sulfur

United States demand for sulfur is expected to increase from 5.0 million long tons in 1950 to 10 million long tons in 1975. In 1950, 83% of the demand was met by Frasch-process sulfur, and in 1951 this had dropped to 78%. It seems certain that if the 1975 demand for sulfur is to be met, non-Frasch-process sources of sulfur will have to supply an even larger proportion than at present. These include pyrite, by-product sulfur dioxide, and hydrogen sulfide extracted from refinery and natural gases.

United States reserves of all forms of sulfur available at the 1951 price of sulfur total 100-150 million long tons. However, if the price of sulfur were increased by 50%, i.e. from $22 to $33 per long ton, the reserves of all forms of sulfur would be increased to 250-400 million tons. An even higher price for sulfur would bring in gypsum and anhydrite as sources. and these materials are available in unlimited quantities. Therefore, there is no prospect of a real shortage of sulfur, although a gradually increasing price of sulfur seems likely, as higher-cost sources have to be tapped to meet the mounting demand.

One aspect of the sulfur question not sufficiently emphasized in the PMC report is that higher prices of sulfur may drive the fertilizer industry to forms of fertilizer not requiring sulfuric acid. Since fertilizer takes over 50% of all the sulfuric acid and since 75% of sulfur goes to make sulfuric acid, such a development in the fertilizer industry could act as a strong brake on increasing sulfur prices.

Fluorspar

United States demand for fluorspar is expected to increase from 426,000 tons in 1950 to 1,150,000 tons in 1975. This demand cannot be met by domestic production of fluorspar plus imports, even if the price is raised materially. The only hope of

THE U.S. OUTGROWS ITS RESOURCE BASE

Figure 1

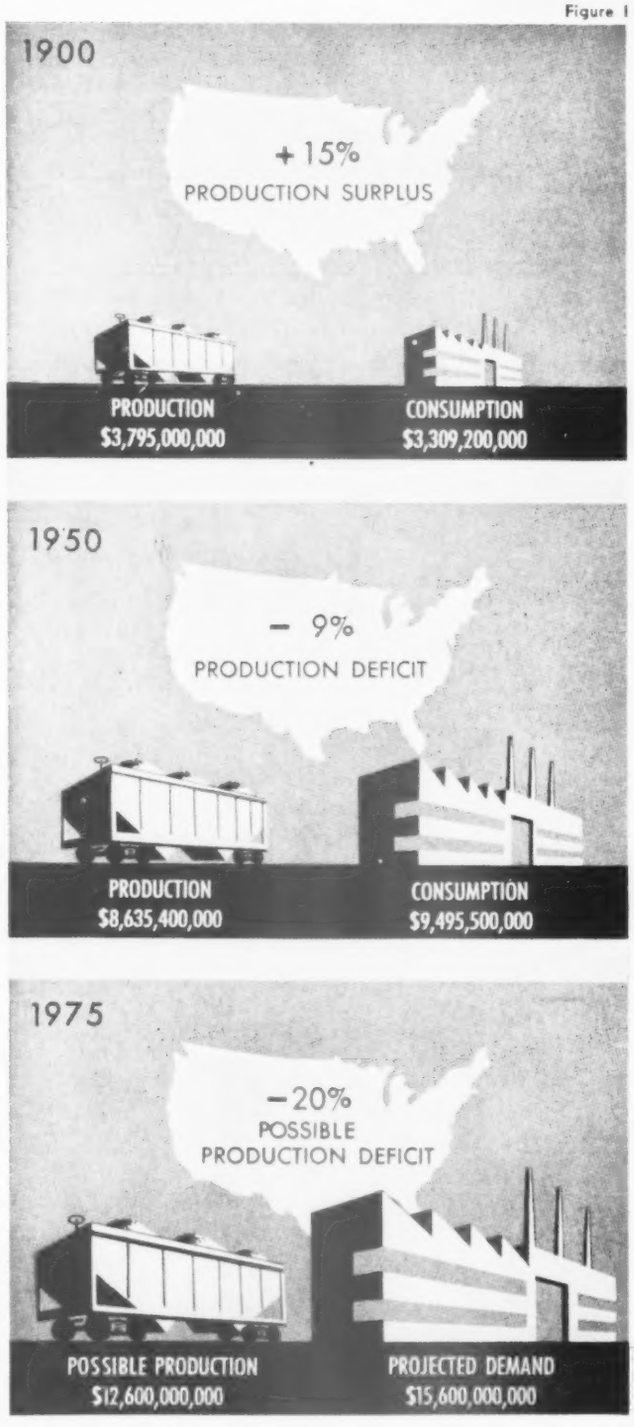
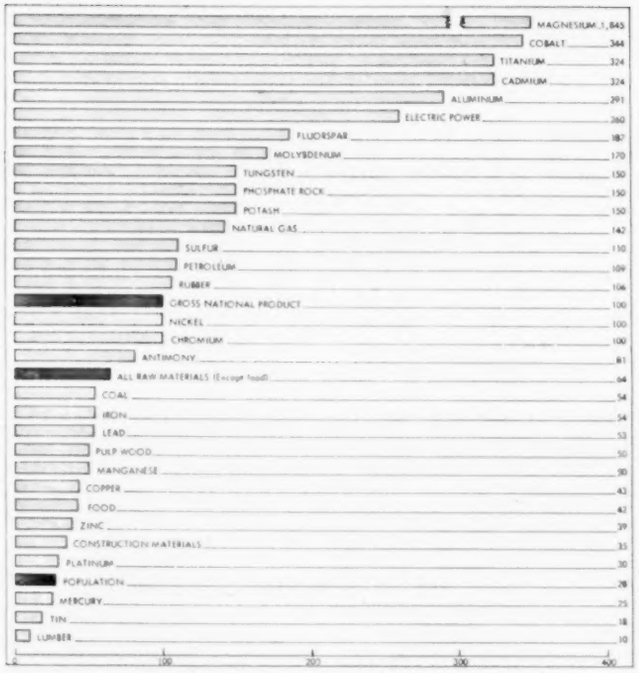


Figure 2

FORECAST OF DEMAND FOR RAW MATERIALS IN 1975

Percent Increase over 1950



meeting this demand is from by-product fluorine compounds from phosphate rock. Much research and development work remains to be done if these processes are going to be available in time to avert a fluorspar shortage. The PMPC believes 1975 demand for fluorine may be met as follows:

	Tons of fluorspar or equivalent
U. S. Production of fluorspar	300,000
By-product from phosphate rock	650,000
Imports of fluorspar	200,000
	1,150,000

Organic Chemicals

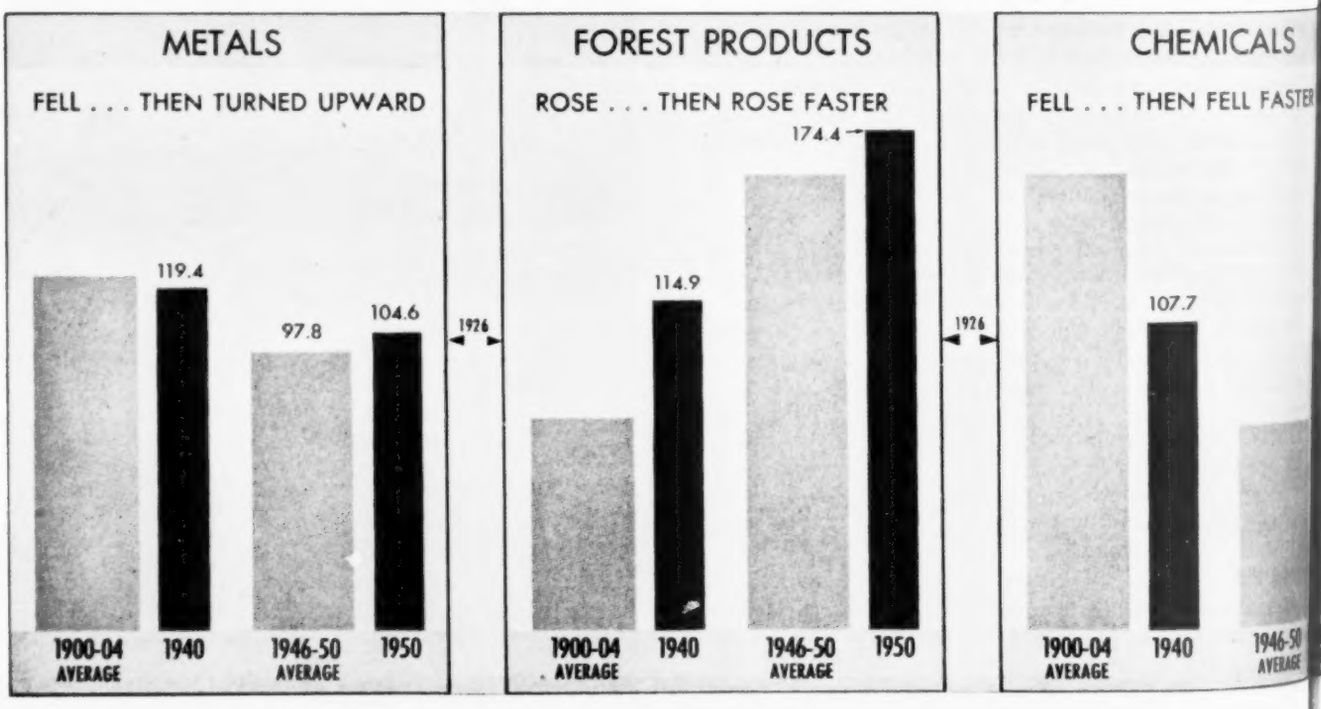
The forecasts on organic chemicals are distributed among four chapters: Vol. II, Chapter 21; Vol. IV, Chapter 12 (Koppers Chapter); Vol. IV, Chapter 13 (Egloff Chapter); and Vol. IV, Chapter 14 (Standard Oil Development Chapter). There are many cases of differing premises and widely divergent conclusions among these chapters, and apparently no attempt was made to reconcile these differences. Each of these four chapters was printed as submitted by the authors (except for some editing and deletions), and none of the authors of these chapters saw the other chemical chapters before they were printed. This makes an unsatisfactory and confusing situation where forecasts exhibiting wide divergence are given in the same report.

Table 1 compares a number of forecasts from three of the chemical chapters. Some of the independent forecasts are in quite good agreement, while others are in marked disagreement. For example, the 1975 forecasts on acetylene, 3,000 and 3,914 millions pounds, and on benzene, 1,149 and 905 million gallons, are in fair agreement, considering the time interval concerned. However, extreme disagreements are seen in the 1975 forecasts for formaldehyde, 8.0 and 3.5 billion lbs., DDT, 620 and 200 million lbs., synthetic plastics, 22.8 and 9.0 billion lbs., and synthetic fibers, 3.1 and 7.0 billion lbs.

REAL PRICES OF SOME M

INDEX NUMBER (1926=100)

Figure 3



In the case of plastics, it seems to the writer that Egloff's 9.0 billion lbs. is much too low—at least, it would require a marked downward deviation from the historical growth rate of plastics. In the case of synthetic fibers, it seems to the writer that the forecast of 3.1 billion lbs. given in Vol. II, Chapter 21, is absurdly low considering that synthetic fibers were 1.5 billion lbs. in 1951 and their growth rate is about 13% per year. In this chapter, the statement is made that fiber consumption has been "approximately constant for over 30 years at 39 pounds per capita," which is not in agreement with historical facts at all. This generalization leads the writers of this chapter to a forecast of 7.5 billion lbs. consumption of all fibers in 1975, whereas almost any correlation analysis leads to figures of 9 to 11 billion lbs.

Unfortunately, none of these chapters gives any description of the methods used to arrive at the forecasts presented. In the Koppers chapter, many forecasts for 1975 were apparently taken as 10 times the 1950 consumption, for example, acetylene, cyclic insecticides, DDT, 2,4-D, cyclic plastics, styrene resins, phenolic resins, phthalic alkyd resins, and cyclic plasticizers. This is a straightforward, but rather oversimplified, method of arriving at 1975 forecasts.

A significant example of the difference in viewpoint between the Egloff and Koppers chapters—petroleum vs. coal—is that Egloff assumes that most of increase in phthalic anhydride will come from petroleum orthoxylene, whereas Koppers assumes that virtually all phthalic anhydride will continue to be made from naphthalene. An interesting prediction of Egloff's is that di-isooctyl phthalate will amount to 540 million lbs. in 1975 out of a total plasticizer production of 900 million lbs.

Coal vs. Petroleum as Sources of Organic Chemicals

The Koppers chapter appears to lean over backwards to make a strong case for chemicals from coal. For example, predictions of 2.19 billion lbs. of naphthalene, 2.1 billion lbs. of cyclic insecticides, and 4.0 million tons of GR-S rubber in 1975 appear to the writer to he over-optimistic on these aromatic chemicals. This chapter is based on the assumption that there will be a large synthetic liquid fuels industry producing 800,000 bbls. per day of liquid fuels by coal hydrogenation, 700,000 bbls. per day by Fischer-Tropsch process, and 1,400,000 bbls. per day from shale oil. These operations would have the following *potential* by-products:

1,350,000,000 lbs. of phenol
1,290,000,000 lbs. of cresols
850,000,000 gals. of benzene
1,500,000,000 gals. of toluene
1,700,000,000 gals. of xylene
2,900,000,000 lbs. of naphthalene
51,000,000 gals. of ethyl alcohol
1,700,000 tons of sulfur
1,880,000 tons of ammonia

On the other hand, the Egloff and Standard Oil Development Company chapters assume there will be no synthetic fuel industry at all in 1975. The summary section of the report (Vol. I, p. 110) presents a balanced judgement that "large-scale synthetic oil production . . . . . is some years off at best."

The Egloff chapter gives demand and potential supplies of olefins in 1975 as follows:

	Billions of lbs.	
	Demand	Potential Supply
Ethylene	7.0	34.0
Propylene	3.56	42.5
n-Butylenes, Isobutylene	4.7	52.8

MAJOR RAW MATERIALS

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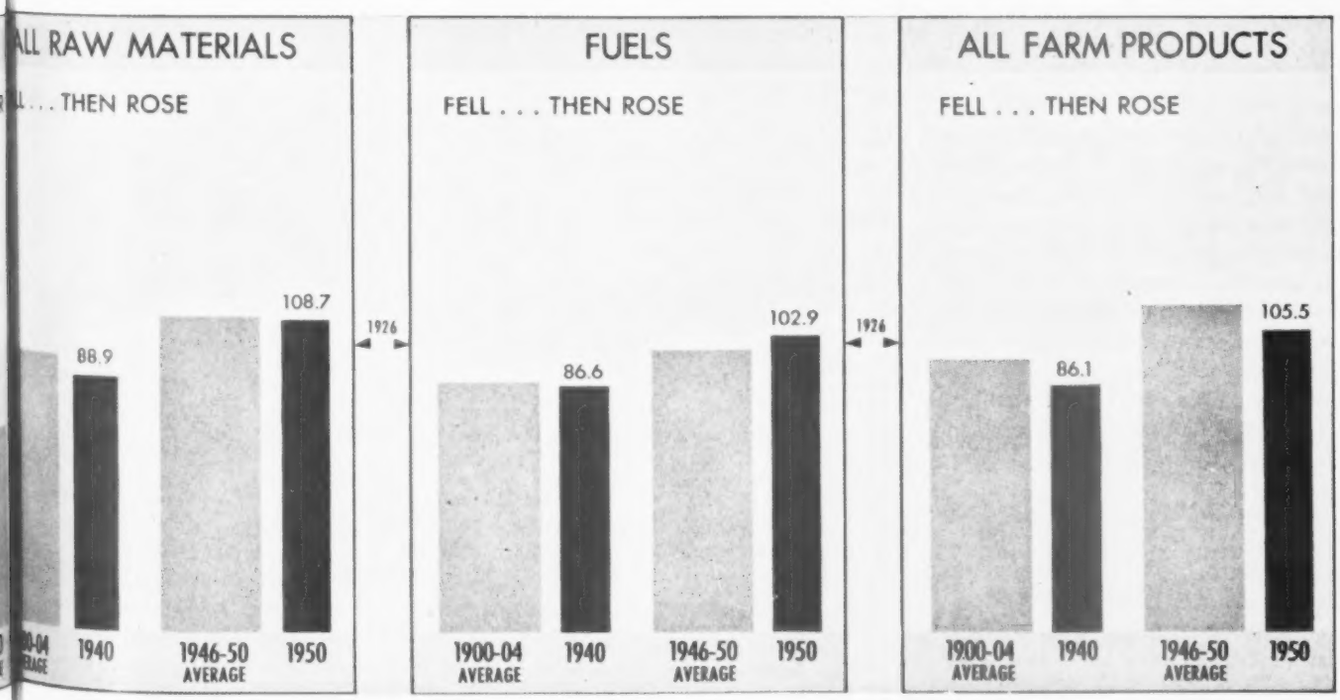
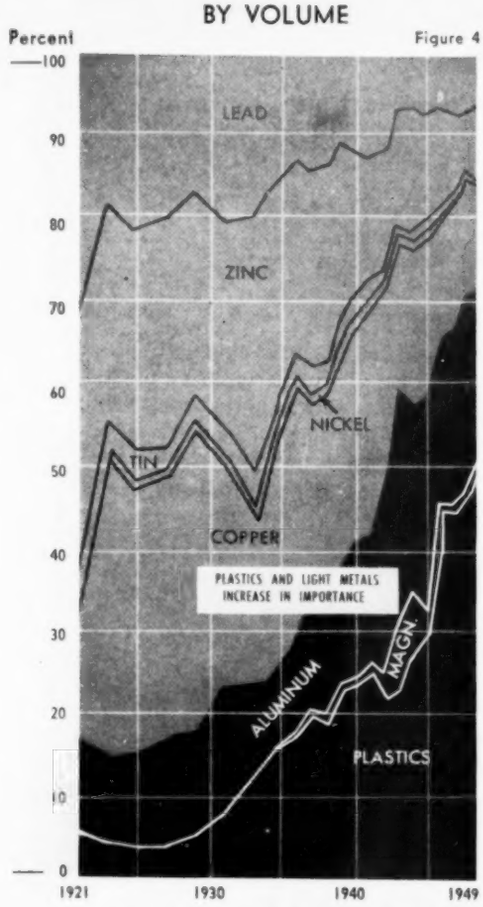


Growing Importance of Plastics and Light Metals

BY VOLUME

Figure 4



Source: Bureau of Mines; Stanford Institute of Research.

These seem to be reasonable figures to the writer. The big requirements for ethylene stated by Egloff are ethyl alcohol, ethyl chloride, polyethylene, styrene, vinyl chloride, ethylene glycol, acrylonitrile, and other uses of ethylene oxide. The big requirements for propylene are isopropyl alcohol, glycerine, allyl compounds, and alkyl aryl sulfonate detergents. The big requirements for butylenes are synthetic rubbers and methyl ethyl ketone. The Standard Oil Development Company chapter presents a discussion of olefin requirements which generally agrees with that of Egloff.

In the plastics field, the Koppers forecasts for styrene resins and phenolic resins seem quite reasonable to the writer, although their forecast for phthalic alkyd resins seems high, in view of the restriction of alkyd resins to the surface coatings field. The Koppers chapter gives no forecasts on aliphatic plastics. On the other hand, the writer feels that Egloff's forecasts on plastics

Comparison of Forecasts in PMPC Report

(Millions of lbs., except as noted)

Table I	1950 Actual Consumption	1955 Demand Koppers Vol. IV	1955 Demand Egloff Vol. IV	1975 Demand Anonymous Vol. II	1975 Demand Koppers Vol. IV	1975 Demand Egloff Vol. IV
Sulfur (M long tons)	4,806	—	6,200	9,600	—	12,300
Chlorine (M tons)	2,066	—	—	8,000	—	—
Ammonia (M tons)	1,751	3,235	5,200	—	6,710	10,400
Ethylene*	1,536	—	2,550	—	—	7,000
Propylene	882	—	1,561	—	—	3,563
n-Butylenes	904	—	1,940	—	—	4,700
Isobutylene	124	—	242	—	—	
Acetylene	300	550	859	—	3,000	3,914
Benzene (MM gals.)	187	319	392	—	1,149	905
Toluene (MM gals.)**	84	—	68	—	—	145
o-Xylene (MM gals.)	1	—	37	—	—	94
p-Xylene (MM gals.)	0	—	4	—	—	104
Xylenes, mixed (MM gals.)	71	—	55	—	—	124
Naphthalene	455	700	—	—	3,120	—
Methanol (MM gals.)	140	320	224	—	875	428
Formaldehyde (37%)	835	—	1,830	—	8,000	3,500
Halogenated hydrocarbons	2,000	—	—	9,500	—	—
Ethylene glycol	519	—	558	—	—	900
Ethyl alcohol (MM gals.)	232	—	285	—	—	700
Styrene	540	1,000	—	—	3,935	—
Phenol	312	600	—	—	2,806	—
Cresols	56	135	—	—	448	—
Aniline	98	126	—	—	189	—
Phthalic anhydride	216	400	—	—	2,192	—
Di-Isoctyl phthalate	3	—	210	—	—	540
Insecticides, organic	177	—	—	500	—	—
Insecticides cyclic	210***	325	—	—	2,100	—
DDT	62***	87	125	—	620	200
BHC	57***	—	170	—	—	225
2,4-D	30***	—	40	—	300	80
Medicinal chemicals	49	—	—	61	—	—
Plastics (all)	2,280	—	3,500	22,800	—	9,000
Plastics, cyclic	1,284	2,690	—	—	12,800	—
Styrene resins	355	890	500	—	3,550	1,500
Phenolic resins	316	650	850	—	3,160	1,800
Alkyd resins (all)	402	—	530	—	—	1,330
Phthalic alkyd resins	333	560	—	—	3,330	—
Vinyl resins	381	—	700	—	—	2,000
Urea and melamine resins	219	—	265	—	—	570
Polyethylene	55	—	200	—	—	1,000
Cellulosic plastics	130	—	135	—	—	175
Plasticizers (all)	243	—	350	—	—	900
Plasticizers, cyclic	180	300	—	—	1,800	—
Rubber (M long tons)	1,620	—	—	3,300	—	—
Natural rubber (M long tons	738	—	—	2,500	—	—
Synthetic rubber (M long tons)	538	—	—		—	2,000
Reclaimed rubber (M long tons)	300	—	—	800	—	—
GR-S Rubber (M long tons)	358	850	—	—	4,000	—
Rubber chemicals, cyclic	98	117	—	—	450	—
Fibers, total	6,842	—	—	7,500	—	—
Fibers, natural	5,346	—	—	4,400	—	—
Fibers, synthetic	1,496	—	—	3,100	—	7,000
Fibers, syn. (ex. rayon)	145	—	—	1,200	—	4,000
Nylon	100	—	—	—	—	800
Dacron	45	—	—	—	—	1,000
Orlon, dynel, etc.		—	—	—	—	1,200
Other syn. fibers		—	—	—	—	1,000
Rayon, total	1,351	—	—	1,900	—	3,000
Viscose rayon	911	—	—	—	—	2,100
Acetate rayon	440	—	—	—	—	900
Surface-active agents, total	676	—	—	3,000	—	—
Surface-active agents, cyclic	383	936	—	—	1,865	—
Synthetic detergents (40%)	1,660	—	2,000	—	—	4,000

*Estimated demand if carbohydrates and acetylene are used to produce some potential ethylene chemicals.

**Not including toluene for TNT.

***These figures are cited in Koppers chapter, Vol. IV. However, correct 1950 production figures are 175, 78, 77 and 26 million lbs., respectively, for cyclic insecticides, DDT, BHC, and 2,4-D.

are much too low. Nine billion lbs. for plastics in 1975 seems much too low for a product as versatile and with such a high historical growth rate as plastics. Styrene resins at 1.5 billion lbs., phenolic resins at 1.8 billion lbs., and polyethylene at 1.0 billion lbs. in 1975 all seem to the writer to be too low for 25 years growth. Even vinyl resins at 2.0 billion lbs., and urea and melamine resins at 570 million lbs. seem somewhat low.

In the synthetic rubber field, Vol. II gives total new rubber demand (natural and/or synthetic) as 2.5 million tons in 1975, Egloff gives 2.0 million tons for all types of synthetic rubber, and Koppers gives 4.0 million tons of GR-S alone. A correlation of rubber demand with petroleum demand indicates that the Vol. II and Egloff figures are reasonable and that the Koppers figure is much too high. The Koppers figure was arrived at by assuming that 1975 demand for rubber would be 5 times 1950, that 85% of the demand would be met by synthetic rubber and that GR-S rubber would be the same percentage of total synthetic rubber as it is today. Of all these three assumptions, the first is the least tenable, since rubber demand follows petroleum demand very closely and no one has suggested a 1975 petroleum demand more than twice that of 1950.

* * *

Despite its shortcomings, "Resources for Freedom" is an historic document and one which every scientist, engineer, metallurgist, economist, political scientist, social scientist and historian should read. Many sections of the report are beautifully written and worth reading for literary value alone, particularly Volume I which was written or supervised in writing by Eric Hodgins of Fortune Magazine.

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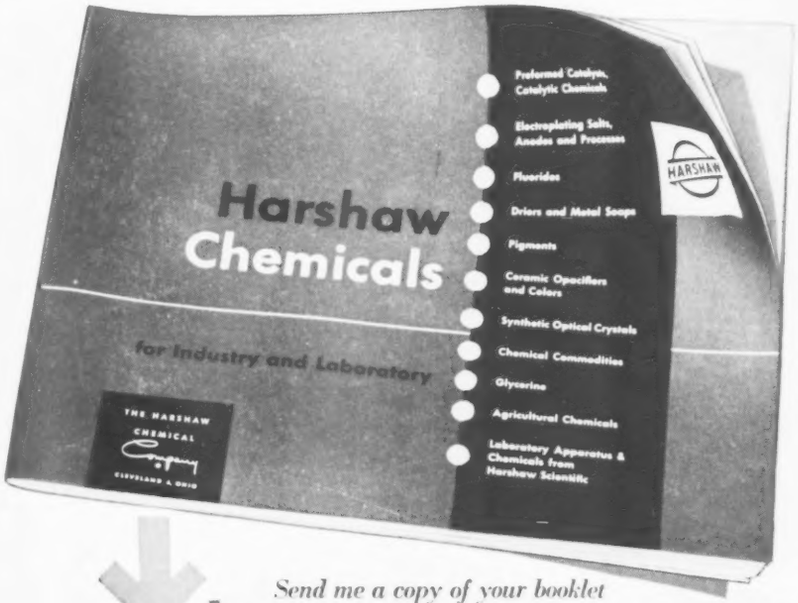

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—U.S. Army Photo

The Japs felt the wrath of Chinese-operated 4.2's in the jungles of Burma.

—U.S. Army Photo

A "rapid fire" order to a 4.2 crew results in six white phosphorous shells bursting almost simultaneously to form a demonstration smoke screen.

"FIRST ROUND ON TARGET"

By CAPTAIN EARLE J. TOWNSEND*

The grizzled old Infantry colonel looked at the fresh, young Chemical Warfare Service officer and then over at the strange looking contraption which resembled nothing so much as a piece of stove pipe set on a square piece of metal.

"Your target, captain, is that hill yonder, and that small clump of trees in particular", he said, pointing to one of Fort Benning's sandy knolls.

A few minutes later there were three hollow-sounding "whoomps". The captain and his small crew from Edgewood Arsenal crossed their fingers and held their breaths. In a matter of seconds there were two explosions in the clump of trees, and one off to the edge.

As the captain anxiously looked at the colonel, the old-timer gazed at the haze of dust and smoke rising from the "target" and rubbed his chin with his knuckles.

Finally he turned to the captain, looked at him and then at the weapon, "Nice shooting, captain." Then he turned and strode away, muttering words that sounded like "impossible".

That, according to a Chemical Corps legend was the Infantry's introduction to the 4.2-inch chemical mortar. The time was back in the mid-twenties.

Today, some 25 years later, the Infantry has completely adopted the 4.2-inch mortar as its "own". The final transition is now being made as the Corps' three Chemical Mortar Battalions are being converted into Infantry Heavy Mortar Battalions under a Department of Army order issued in October.

The first weapon inseparably linked to the old Chemical Warfare Service, the 4.2-inch mortar, has now taken its rightful place in the Department of Defense's arsenal of weapons.

All the years of painstaking trial and error developmental work, the years of war effort with their grief and toil were summed up succinctly by Major General E. F. Bullene, the Chief Chemical Officer, when he wrote, in a letter to the field recently: "I feel that the Corps should be proud of the fact that we developed and fought a weapon that has become so highly prized by the Infantry that it is now an integral part of that arm's weapons system."

For no one person or unit can really be singled out as the "salesman" in making the Infantry realize that here was a "good buy". It has been a cooperative effort, involving action throughout the world by many men and many units. To these officers and men—some in a "former" status and some still on active duty—conversion of the Chemical Mortar Battalions to Infantry units may have come as somewhat of a blow, they may have felt as if they were losing an old friend.

But, as General Bullene points out, "The 4" Stokes Mortar and the Livens Projector were chemical weapons which belonged to World War I. The 4.2-inch Chemical Mortar was a chemical weapon which belonged to World War II. These weapons were effective in their day and reflected the technical knowledge of those times. Our research and development program is being pursued with vigor and our chemical weapons battalions of the future will be equipped with weapons that reflect the added knowledge gained through this program."

The 4.2 was never used for the purpose it was originally intended—the laying down of toxic agent concentrations. But it was used, and used with unprecedented effect, in supporting the fighting ground forces who needed something heavier than the 81 mm. mortar in areas where heavy artillery fire could not be brought in because of the terrain or where the artillery fire needed thickening. The Korean "police action" has been the payoff on this, and today the 4.2 has passed completely out of the Chemical Corps hands.

Changes have been made in the 4.2 in order to make it a better Infantry-support weapon. The difference between the weapon that was developed at Edgewood in the mid-twenties and the 4.2 of today is great. The old models, M1A1 and M2, were designed to throw toxic agent shells in a heavy concentration up to around 3,000 yards. Today's 4.2, the M30, has a longer barrel, can swivel around 360 degrees without moving the baseplate and fire a modernized shell some 6,000 yards . . . but it still has the original idea— a muzzle-loading, rifled barrel weapon that can fire a hard-hitting, but comparatively light, shell at pin-point targets and hit them on the nose.

The reasons for the changes can best be summed up in this manner: as a gas dispersion weapon, the 4-2-inch mortar required a semi-rigid steady mount; as an Infantry-support

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—U.S. Army Photo

The 2nd Battalion found the mountains of Korea just as steep as those of Italy.

weapon, a great flexibility of fire was required. By the end of the war, Technical Command personnel had developed the "E37" model 4.2 . . . a heavy mortar that fulfilled all of the requirements for an Infantry-support weapon, and which is today's M30.

The development of the 4.2-inch chemical mortar was not the result of the effort of one man or a group of men. The development period really covered the 23 years prior to 1948. During this time men came and went, but the 4.2-inch mortar stayed on, for many years a challenge to those who sought to determine the cause of a premature burst, a tumbling shell, a bent elevating screw, or a broken tie rod.

The development reached its finale so far as the Chemical Corps was concerned on December 31, 1947, when, upon orders from the Chief of Staff, Department of Army, the 4.2-inch chemical mortar, M2, was made an item of procurement and issue by the Ordnance Corps to all defense agencies requiring its use. This was because the Army Field Forces had adopted the weapon as one organic to the heavy mortar company of the Infantry battalion. At the same time, the Marine Corps made it an integral weapon of their heavy weapons units.

The action in converting the Chemical Mortar Battalions to Infantry outfits came as a natural course of events resulting from the above action. For, when the Infantry adopted the 4.2, that made two types of units on the front lines doing exactly the same job. This complicated higher echelon planning, as it added a third element to the Artillery-Infantry team. The difficult situations that might arise from this are not hard to understand. In General Bullene's opinion, the Army order turning the Corps' mortar battalions over to the Infantry "is a forward stride in simplification of command."

In fact, General Bullene was ready to recommend that such action be taken when the Army Chief of Staff ordered the change made. The command line, and the misuse of the Chemical Mortar Battalion in combat was making the situation increasingly difficult. The only solution was to put the mortar battalion where it could do the most good—in the Infantry. (Elsewhere in this issue of the JOURNAL are a series of letters which point up this situation very well.)

The 4.2 was a fine weapon when first developed for its intended use—the laying down of toxic agent concentrations in answer to enemy use of gas. However, many new developments were made in the 4.2 to increase its efficiency as an Infantry support weapon and it no longer fulfills the need for a chemical projector.

The decision to form Infantry 4.2-inch Mortar Battalions does not deprive the Chemical Corps of combat units, for the Second Chemical Mortar Battalion, which has been on the Korean front, will be designated as the Second Chemical Weapons Battalion. It will be a unit specifically designed, equipped, and manned to meet the needs of accomplishing the Corps' tactical mission should the enemy resort to gas warfare. Its whole operational mission will be for, and by, the Chemical Corps with types of equipment that are peculiar to the Corps and must be manned by trained Chemical Corps personnel. And, the new battalion—which is expected to be activated at Dugway Proving Grounds, Utah—will carry on the fame and lineage of the Second Chemical Mortar Battalion, whose battle streamers and battle records of World

The new M30, left, dwarfs its older brother, the M2 of World War II fame. The newer model has a swivel-type baseplate, longer barrel and greater maximum range, but still possesses the characteristics of the original 4.2.

—U.S. Army Ordnance Corps Photo

War I and World War II, including those earned in Korea up to the very day of complete transfer, will be a part of the Second Chemical Weapons Battalion history. The lineage of the 2nd can be traced directly back to the First Gas Regiment of World War I days—the original Chemical Warfare Service combat unit.

Besides the Second, the Infantry will take over the 3rd Chemical Mortar Battalion which has been training at Fort Bragg, North Carolina, and the 467th Chemical Mortar Battalion which is in training at Camp Atterbury, Indiana. In each case, the officers of the units will be returned to duty with the Chemical Corps while the enlisted personnel will be integrated into the Infantry and continue to service their 4.2's.

The predecessor of the 4.2 was a World War I weapon known as the Stokes 4-inch trench mortar. It was used for more than three years by the British, and nearly a year by United States special gas troops, to lob chemical agents and thermite on the German front-line with a great deal of success. The Stokes was designed for placing sudden and high concentrations of agent on limited objectives at a close range. Material hits were not necessary, all that was required was that the dispersion be greater than the target area to be covered.

After the first World War, the question arose whether the Stokes was to remain a weapon of the Chemical War-

In the South Pacific, the 4.2 "went to sea" in landing craft to become a deadly beach assault weapon.
—U.S. Army Photo

fare Service (name changed to Chemical Corps after World War II) or be turned over to some other branch. Lt. Col. Claude E. Brigham (later a major general and Chief of the CWS, 1933-1937) represented the Chemical Warfare Service at Fort Benning in 1924 on the subject. He won his point, and the Stokes was retained by the chemical service.

But there were deficiencies in the weapon. Being a smooth-bore piece it fired a shell that tumbled in flight, thus necessitating an all-ways fuse that would detonate in any impact position, the efficient liberation of the agent from the shell was impaired since the position on impact could not be predicted or controlled; the maximum range of the tumbling shell was 1100 yards; and the wooden baseplate needed renewal after about 20 rounds had been fired at the maximum range. Thus, there was some difference of opinion on the value of the Stokes, but work was carried on in an attempt to perfect it into a more effective weapon.

However, a young officer by the name of Lewis M. McBride

—U.S. Army Photo
Snow and chow-time didn't stop the 87th from answering a "fire support" call.

(then a captain and later retired as a colonel) had an idea of his own. His solution—rifle the barrel and have a true-flight shell. Under his guidance, Stokes barrels were rifled —the cutting of the grooves creating a barrel 4.2 inches in diameter; shells were designed and developed; and within a matter of months a new weapon had been born. Although far from complete, it showed promise for the rifled barrel sent the shell twisting through the air, not tumbling, to fall upon a point target rather than an area target; it made sure the shell would impact with the nose first; and the range was increased. In the next decade the 4.2-inch mortar was under continual development, especially in the direction of increased mobility, and it was successfully tested in many Army maneuvers in support of Infantry units. Until 1942, however, it remained a chemical mortar, designed to fire toxic agents and to lay smoke screens.

A special thin-cased shell of high chemical efficiency had been developed for the mortar, the agent or smoke filling being between 6 and 7 pounds of the total weight of the 25-pound round. As a purely chemical weapon, the mortar had but limited usefulness to our ground forces, but in 1942 chemical mortar shells from which the liquid agitating vane had been removed and the chemical filling replaced with 8½ pounds of TNT were tested. This amount of TNT, about 35 per cent of the total weight of the round, was extremely high loading efficiency for any munition and the blast effect of the shell on impact was tremendous. The firing of high explosive in the 4.2-inch mortar, when not otherwise employed in firing gas and smoke, was authorized in March, 1943. The way was cleared for the combat employment of the mortar.

The story of the combat record of the 4.2 mortar is the combined histories of the 25 chemical mortar battalions and two separate chemical mortar companies which have taken it into action against the forces of Hitler, Mussolini, Tojo and lately the Communists in Korea. The heroism, the ingenuity, the

*For a more complete history of these activities see Chapter VIII, The Chemical Warfare Service in World War II, Reinhold Publishing Corp., New York, 1948.

blood, sweat and toil of the men of these units can only be hinted at in a condensed version here because of space limitations.*

Practically unknown in 1942, the CWS mortar troops had been battle tested by 1943, were veterans by 1944, and had become famous throughout the fighting forces by 1945. These troops had a weapon capable of delivering a greater weight of shell in relation to its own weight and mobility than any other weapon in the United States Army—the 4.2-inch chemical mortar. It could deliver massed fire on short call; it could reach, with its high-angle fire, targets inaccessible to artillery; it could be employed sufficiently near the fighting front to give strong support to infantry units; and due to its low silhouette it offered a difficult target to the enemy. A massed battalion could, when necessary, fire nine tons of shell on a target in one minute, move out, set up its weapons in another position within six minutes, and a minute later repeat the dose with the same deadly precision.

When American troops landed in North Africa they were immediately met by the devastating fire of the 15th Panzer Division's 120-mm. mortar. The 60-mm. and the 81-mm. smooth-barreled mortars were the nearest things they had to the Nazi's "120", but they were no match for it in either range or accuracy. However, Chemical officers in the theater, and the Chief's office in Washington, thought they had the answer—the 4.2-inch chemical mortar battalion. They urged the War Department to counter the "120" with the 4.2.

Finally, four 4.2-inch chemical mortar battalions, the 2nd, 3rd, 83rd, and 84th, were shipped to the theater, arriving in May and June 1943, in time for the first three named to be committed for the Sicilian campaign. Though the commanders of the Army Ground Forces were handicapped by their unfamiliarity with the weapon, the 4.2-inch mortar shot its way to recognition during the 38 days of the Sicilian campaign, firing virtually every type of nongas mission.

One of the most effective uses of the mortar was its employment in the first hours of the assault on Sicily during the heavy enemy counter-attacks before the field artillery was landed. On the beach in the first waves they were in action minutes later. With their high-angle fire they were able to pour fire on targets as close as 600 yards. During the enemy counter-attacks on Gela that first day, the 4.2-inch mortars destroyed several tanks, and when the main counter-attack came the next day, a company of mortars assisted in the destruction of nine Mark IV tanks by forcing them to withdraw to a range which enabled artillery and naval gun fire to destroy them. Demonstrating the accuracy of the 4.2-inch mortar, a platoon of the 2nd Chemical Mortar Battalion fired eight rounds at an enemy tank, all rounds falling within a radius of fifteen feet and one round going down the open turret of the tank.

"Up and over" was the thing in Italy's rough terrain for the 2nd, 3rd, 83rd and 84th Battalions.
—U.S. Army Photo

In addition to interdictory and counter-battery fire in Sicily, the mortars also fired numerous tactical smoke screens, concealing our troops both in attack and withdrawal. In attacks near the Furiano River during August 1943, a company of mortars fired screens ranging from 2,000 to 3,500 yards in length, maintaining some of them for as long as 14 hours. Early in August the 2nd Chemical, which was later commended by the Seventh Army for its work, maintained an average fire of almost 100 rounds per hour for forty hours. In the 38 days of the Sicilian campaign a total of 35,000 rounds was fired by the 4.2-inch mortars in their combat debut.

The chemical mortar had been committed to front line combat support. Its four and two-tenths-inch bore, approximately 107-mm, together with its rifled accuracy, not only made it the equal of the German 120-mm mortar, but slightly superior to it in adaptability and mobility. At the close of the campaign, Army Ground Forces commanders, including Infantry, Rangers, Armored and Airborne divisions, whose units had been supported by the mortars, heaped commendations on the performance of the mortar and the "Chemics". One Commanding Officer said that he wanted chemical mortar troops attached to his battalion at all times, was "scared to death" they would

'Twas cold in Belgium, but that didn't keep the 86th's guns silent.
—U.S. Army Photo

be taken away, and added, "without exaggeration, I would say that the 4.2 is the most effective single weapon used in support of Infantry I have seen."

Beginning at Salerno on 9 September 1943, and continuing until VE-Day, the Italian campaign probably made the most gruelling demands on chemical mortar battalions and the 4.2 of any in World War II. The terrain of Italy was ideal for mortar operations; and Army Ground Forces commanders, on the basis of operations in Sicily and the early operations in Italy, came to demand the support of the 4.2 at all times. With only four mortar battalions in this theater at any one time and with as many as sixteen Infantry divisions and five Ranger and Commando units in the line with the Fifth Army, the mortar units were seldom out of action.

Infantry units were taken out of the line for rest, but the supporting mortar battalion was nearly always attached to a fresh division and stayed on, until, in the words of the combat mortarmen, they were "part of the terrain." All division

commanders wanted the support of a chemical mortar battalion and both the Commanding General and the Chief of Staff of the Fifth Army said they "would not willingly send a division into action without the support of a battalion of 4.2-inch mortars."

The four chemical mortar battalions that took part in the Italian campaign, the 2nd, 3rd, 83rd and 84th, had no rest until VE-Day. The 2nd Chemics, after pulling their mortars across the length of Sicily, landed in Italy and fought with the Infantry all during the drive north. For the invasion of Southern France, one company landed behind the enemy's lines in gliders, then marched with the battalion through France for the drive on Germany's frontier. The 3rd Chemical Mortar Battalion saw its share of combat in the tough Italian campaign, spearheaded the invasion of Southern France in mid-August 1944, and drove its way north to the Siegfried Line.

On 22 January 1944, two nights after a Ranger task force was surrounded and virtually wiped out at Cisterna, Italy, Axis Sal went on the air: "Now that the Rangers are finished, the 83rd Chemical Battalion is next," she boasted. But on VE-Day the 83rd Chemics were still going strong. Exactly 540 days in combat was the record of the 83rd Chemical Mortar Battalion, extending over two years, two continents, five countries and six major campaigns. During that time it supported 17 Infantry divisions, 3 Armored divisions, 2 Airborne divisions and numerous task forces including American Rangers and British Commandos.

The 84th Chemical Mortar Battalion had run up a total of 450 days in the line by February 1945. It fought for 118 consecutive days following the landing at Salerno on 9 September 1943. This was the battalion that blinded German observation with a smoke screen stretched for three miles along the Volturno and towering a thousand feet high enabling our Infantry forces to cross the river safely. At another time, during a mass attack on our positions, the battalion fired white phosphorus shells behind the oncoming Germans, silhouetting them against the white smoke and making them good targets for our small arms fire. No infantrymen crouched behind his Garand could have asked for a sweeter set up.

The 84th went ashore again at Anzio on 22 January 1944, and was in continuous combat for another 138 days. They stayed on the beach through almost four months of bitter fighting to save Anzio from the desperate Nazi effort to throw the beachhead back into the sea. The 84th was relieved north of Rome in June only to be committed again a month later for the assault on the Gothic line and the drive up the peninsula to the Po Valley.

The chemical mortar battalions seldom operated as one unit. Companies, and sometimes even platoons of companies, were separated from the battalion and attached to various units of the Fifth Army who needed the mortar support. This procedure was used wherever the Chemics and their mortars went into action, including the fighting in Korea where the 2nd has won more fame.

In the Mediterranean Theater of Operations, the four chemical mortar battalions fired approximately 500,000 rounds of ammunition in the first year of combat. This was terrific punishment for their weapons since the mortar, developed to fire quick concentrations of gas or smoke at short or medium ranges, was found to reveal certain weaknesses when subjected to the steady pounding of TNT shell. Not only had the mortars been in almost continuous action in this, their first combat experience, and under the severest conditions both of weather and terrain, but Infantry commanders had repeatedly called on them to fire high explosive at the medium and extreme ranges. The authorized maximum range of the mortar at the start of the war was only 2,400 yards. Although the range had been extended to 3,200 yards, the targets that the Infantry wanted smashed were 4,000 and 5,000 yards away. The mortarmen simply piled on more powder rings, let the round slide down the barrel, and prayed. But the unnatural strain told. Tie rods bent and buckled, recoil springs were fractured, and even the steel baseplate cracked wide open under the repeated impact of loads far beyond the 4.2's rated load. The barrel alone seemed indestructible. By the end of 1943, with a new recoil spring, a heavier baseplate and a brand new propellant, a redesigned mortar, the M2, went into the field with an authorized increased of range from 3,200 yards to a new high of 4,397 yards. The tough M2 was ready for the beaches of Normandy.

Four chemical mortar battalions were in England by D-Day. Two of them, the 81st and 87th, were part of the initial landing forces on the morning of 6 June 1944. The 86th and 92nd followed soon after. By August, three of the four battalions which had been operating in the Mediterranean theater for more than a year went into Southern France as a part of the invasion forces of the Seventh Army. By the end of 1944, two additional battalions had also been commited to the European theater, making a total of nine battalions in action—and by then,every division in Europe wanted the support of a chemical mortar battalion.

During the initial beachhead operations on D-Day, mortars of the 81st knocked out enemy machine gun nests, laid screens for the attacks and advances of the Infantry and broke up enemy counterattacks with massed fire. After Omaha Beach was secured, they supported Infantry and Airborne troops in the vicious hedgerow fighting across the fields of Normandy and in the reduction of the strong points and fortresses at Montebourg, St. Lo and St. Malo. After 85 days of action in France, the 81st, within a single week, moved through four countries. Two of its companies crossed from French to Belgian to German soil; another went from France into Luxembourg one day, and the next day moved into Germany. It was two companies of the 81st that fired 20,000 white phosphorus shells along the length of the Saar River in December 1944, to cover our crossing into Germany for the final victory drive.

The first guns in action on Utah Beach on D-Day were the 4.2's of the 87th Chemical Mortar Battalion, which landed at H-Hour with the Infantry. Ten minutes later they were firing at targets over the cliffs. The 87th went with the VII Corps which had the port of Cherbourg as its objective. Once, when four German 88-mm guns began shelling a regimental command post near the port, four mortars were sneaked into position only 1,200 yards distant from the 88's and opened up with high explosive. The 88's—which weighed 5 tons against the 300 pounds of the 4.2-inch mortar—quickly picked up the mortar position but failed to score a single hit. After ten minutes of duelling, the fire from the 88's ceased and the Chemics were officially credited with a knock-out.

The 86th and 92nd Chemical Mortar Battalions landed in France on 1 July 1944, and went into action almost immediately. As the 86th crossed Northern Europe it lent support to 21 different Infantry divisions, serving with the First, Third and Ninth Armies, in almost eight months of continuous combat. During the historic Battle of the Bulge in December 1944, Company C of the 86th met the full tide of the German drive into Belgium when, striking suddenly, a desperate force of Nazi tanks and infantry rolled toward the 38th Regiment of the 2nd Infantry Division. This spearhead of Von Rundstedt's assault was only 2,000 yards away when Company C got orders to cover the withdrawal to stronger positions. The eight mortars began pouring the fire and smoke of white phosphorus into the oncoming enemy. Enemy tank drivers lost their sense of direction and the German infantrymen became panicky. Then the Chemics switched to high explosives and the enemy offensive ground to a standstill, losing momentum at that point for 90 minutes. In this breathing space, the American forces pulled out and withdrew to new positions. The Chemics kept right on feeding the muzzles of their mortars while streams of U. S. infantrymen fell back

past the mortar positions, followed by the remaining artillery, the smaller guns and finally the tanks. Then, their job done, the mortarmen moved out under cover of darkness.

The 92nd Chemical Mortar Battalion arrived in France in time to participate in the St. Lo breakthrough of July, 1944. Supporting the 35th Infantry Division in its attack on Hill 122 before St. Lo, the 92nd's mortars banged out 7,000 rounds during a continuous 14-hour assult on the German-held hedgerows. By September they were fighting at the side of the 30th Infantry Division in its drive against the Siegfried Line, consistently operating as close as 100 to 1,000 yards from our most forward elements. It was in this theater of operations that a new method of employing mortar units was developed, that of attaching them to corps and division artillery, to supplement or complement the role of artillery and to add to the weight of massed fire. The 92nd was one of the first outfits to employ artillery methods of fire under artillery control, sharing targets with the guns and howitzers and taking commands from the artillery fire direction centers.

Included in the Seventh Army invasion forces that landed near Cannes in Southern France in mid-August of 1944, were three mortar battalions, two companies of which were airborne —the first instance of the use of chemical mortar units in airborne glider assaults. The three chemical battalions moved up through France with the Armies of General Jake Devers, while the four chemical battalions in the north operated with the Armies of General Omar Bradley. During September and October 1944, all United States forces were massing before Germany's Westwall. During the severe fighting of the next five months 12 chemical mortar battalions participated in all the major engagements which crushed the Dragon's Teeth and underground forts of the Westwall. Much of the terrain was rugged, especially in the Seventh Army area to the south, where the Vosges Mountains interposed barriers never before successfully negotiated by an army in modern times. In such terrain the 4.2's were called to fire on many defiladed targets which could not be reached with artillery fire and were out of range of other mortars. The screening of river crossings and bridge-building operations called for heavy expenditures of smoke shell; and when a critical shortage in artillery ammunition developed at one period, the chemical units were called on to fire all artillery targets within the range of the mortar. In the Seventh Army area and during the Battle of the Bulge, Infantry lines were often so very thinly held that chemical mortar units frequently operated as front line troops and held gaps in the line with nothing but their pistols, carbines and mortars. The Germans hated the mortar and frequently neglected urgent missions to silence the persistent demon which jumped from position to position before German guns could range in on it. Also bewildering to the Nazis was the fact that a good crew could get 10 shells into the air before the first one had landed.

The 91st Chemical Mortar Battalion landed in France and plunged into the fighting in mid-December during the Battle of the Bulge, having raced to Luxembourg to help secure the Sauer River. In the furious firing in that action several of their mortars turned red hot under the heat of the endless stream of shells poured into them. The 91st specialized in firing smoke screens and within the first month of combat, laid down all types, covering infantry withdrawals and attacks, throwing protective hazes over Medical Corpsmen as they evacuated the wounded over open ground, firing a perpendicular screen in a wrong-way wind along the flank of an

RIGHT, TOP: The Japs in the Philippines moved out when they felt the concentrated fire of the 96th.—U.S. Army Photo.

TOP CENTER: Guns of the 87th helped subdue the Germans near Cherbourg after the Normandy landing.—U.S. Army Photo.

BOTTOM CENTER: In the jungles of the Solomon Islands wet gunny sacks were used to cool the barrels.—U.S. Army Photo.

BOTTOM: The men of the 2nd used empty 4.2 ammo cases to build a chapel and recreation center in Korea. The sign in front dedicates it to the battalion's men who have made the supreme sacrifice.—U.S. Army Photo.

assault force, and even protecting vehicles bringing up hot chow and bedding to the troops in their foxholes.

By the end of 1944 the 4.2-inch mortar and the chemical mortar battalions had become as famous in the European Theater of Operations as had the battalions in the Mediterranean theater. Said the Commanding General of the V Corps: "I have only one battalion in this Corps and I have trouble keeping the peace when I have to withdraw a chemical mortar company from one division and send it to another." A battalion commander of the 22nd Infantry went out on a limb with his artillerymen when he declared that the 4.2 "was much more effective than artillery fire." He added that prisoners told him they dreaded it much more than artillery fire because they could not hear the projectile. They had found too that the pattern dispersed by the explosion of the shell killed more men in the surrounding area than would an artillery shell. Every corps, division and regimental commander was lavish in his praise of the mortar and the battalions and regarded them as indispensable to the successful combat work of the Infantry.

The chemical mortar battalions had fired a total of 2,456,936 rounds of 4.2-inch shell by the end of hostilities in the European and Mediterranean theaters. The 83rd Battalion alone had seen 508 days of combat out of 668 days spent in the theaters, had participated in five amphibious operations and one airborne operation, had been in six major campaigns, fired almost 500,000 rounds, supported 38 different units and received the following awards: 3 Distinguished Service Crosses; 2 Legions of Merit; 39 Silver Stars; 9 Soldiers Medals; 97 Bronze Stars; 5 Croix de Guerre; 876 Purple Hearts; and 91 Oak Leaf Clusters. Another battalion, the 81st, was committed to action a total of 336 days, had supported 22 divisions, fired 212,576 rounds and received the following awards: 6 Distinguished Service Crosses; 29 Silver Stars; 98 Bronze Stars; 4 Croix de Guerre; and 328 Purple Hearts.

The tactical employment of chemical mortar units in the Pacific and China-Burma-India theaters differed considerably from their employment across the Atlantic, due largely to the differences of terrain and climate, Japanese defensive tactics, the wide variety in the size of engagements and our development of amphibious doctrine. The nature of the terrain in the Pacific and the enemy's defensive tactics precluded strict or sustained adherence to the traditional mortar doctrine of massed fire by whole companies or battalions. Firing by mortar platoons became the general practice in the tangled jungles. In the Southwest Pacific area the 4.2 was frequently used in perimeter defense when our small combat units dug in at night. Numerous small task forces, made up of a single mortar platoon attached to a regimental combat team, went in to capture tiny islands such as those in the Palau Group and the Ryukyus. In large-scale operations as many as three mortar battalions would be spread out among ten attacking divisions such as those that went into combat on Hollandia and Luzon.

The development of amphibious assault technique for the mortar was unique. Following the preparatory bombardment of Japanese positions on Angaur Island in the Palau Group, the morning of 15 September 1944, the landing craft made their run for the beach as soon as the heavy barrage lifted. Instantly the Japanese swarmed from their foxholes to their gun positions, set up their mortars in ravines and gullies protected from the naval bombardment and sent their snipers scurrying up the trees. So far everything had gone according to the book. The Japanese knew that the oncoming landing craft would be given close fire support by small rocket ships, but they were prepared to take their losses in the hope of catching the Americans in another bloodbath similiar to that of Tarawa.

Suddenly from the LCI's plunging toward the shore, came a series of dull explosions, and down on the Japanese positions came a hail of 4.2-inch mortar shells. Twenty-five hundred rounds of HE burst on the beachhead, riddling the snipers in the trees, erupting among the mortars in the ravines and gullies and creating havoc at every gun position. The 4.2 had gone to sea. In fixed mounts on each of four Landing Craft, Infantry, were three mortars, firing over the bow as the LCI's moved in to the shore.

The following day, when our troops on Anguar were pinned down by sniper and machine gun fire and had called for a supporting barrage, the mortars on the four ships answered them. So successful were the LCI (M)'s (M for Mortar) that on 1 April 1945 when the 81st Division moved in for the assault on Okinawa, seven groups of six LCI (M)'s each, with a total of 126 mortars led the way to the beaches. Trained by CWS officers, naval personnel kept the mortars going in support of the five Infantry and Marine divisions in the assault.

Companies of 4.2-inch mortar battalions supported at one time or another all 17 Infantry divisions committed to Pacific operations, as well as Marine, Cavalry, and Airborne divisions. From Luzon through Okinawa there were five chemical mortar battalions of three weapons companies each, plus one separate mortar company, attached in support of twenty Army divisions.

The 82nd Chemical Mortar Battalion fired the first 4.2 round in the Pacific war. It was attached to elements of the 25th and 43rd Infantry Divisions for the drive from Guadalcanal up the ladder of the Solomons, to capture Japanese-held airfields and harbors in the Solomons and neutralize the great air and naval base of Rabaul at the tip of New Britain. On 10 September 1943, Company B of the 82nd landed with the 172nd Regiment on the largest of the Stima Lagoon islands and opened up on its Japanese defenders. This island, nameless before this action, became Mortar Island on that day. The next day another force from the 82nd took positions in the swamps of Sagekarass Island just off Arundel and supported the landing of the 27th Infantry on Arundel. Its principal targets were the enemy barges trying to bring in reinforcements and supplies down the island chain, as well as cross-channel barrages into Arundel. In mid-December 1943 when the 37th and Americal Divisions arrived on Bougainville Island to relieve its Marine conquerors, the 82nd, less its Company B stationed at Munda, came with them.

In the historic Battle of the Perimeter, the mortars had their share. The unprecedented scale of Japanese night fighting on Bougainville compelled American forces to establish a solid 13-mile perimeter defense around Empress Augusta Bay. Night after night Japansese patrols probed for weak spots in this defense line, infiltrated through our lines and around our flanks, and planted scouts and snipers to the rear of our troops. Full-scale counterattacks from enemy forces concealed behind ridges or in the jungle undergrowth often followed this reconnaissance of our positions.

To meet these tactics, defenses were established each day before sunset. Barbed wire encircled the bivouac area. Land mines rigged with trip wires dotted the area 200 to 300 yards in front of our positions. Rifles, BAR's, machine guns, Infantry mortars and 4.2-inch chemical mortars were manned behind these barricades. Almost half of all mortar ammunition expended went into the fighting at night. Registration was made during the day on known or suspected enemy strong points and avenues of attack and the mission was fired that night when the attack came. Using shaded flashlight bulbs, luminescent paint, and even fireflies fixed on the aiming stakes, targets were found and fired in the black, shattering night of the jungle. It was on Bougainville that the mortars began firing great quantities of white phosphorus after dark, for it lit up the ugly blackness and the Japanese screamed from fear of its bone-burning flame when it came near.

By day the battalion was engaged in neutralizing enemy positions on the hills and along jungle trails, defending friendly road blocks and engaging targets on reverse slopes

that were inaccessible to the 105's and 155's. Nowhere was the accuracy of the mortar so well valued as in the jungle warfare. Visual observation of where a mortar shell landed was impossible; sound-sensing methods alone were possible. Yet, even with the use of this hazardous method of fire direction, mortarmen were able to "walk" their fire safely to within 25 yards of our own outposts. Most of the 4.2 jungle firing was nerve-racking close-in support of Infantry. And the closer in the better! The Infantry knew what it was to be hit by shells from their own supporting weapons and when the mortar began bringing its shells in toward them they were a little leary. It required extreme accuracy of firing guided by expert sound perception to bring mortar fire as close as 25 to 30 yards to troops we were supporting. But with Japanese just yards away, pinning our forces to the ground, it had to be done. The Infantry just dug a little deeper, kept their heads down and let it come.

"Join the 88th Chemical Mortar Battalion and see the World!" In the first 18 months after beginning basic training in September 1943, members of this outfit had an average of 18,000 air miles behind them, or approximately 1,000 miles per month. The 88th received its baptism of fire on Saipan and Guam, manned its mortars on gunboats at Palau, followed the enemy through Leyte and finally splashed ashore at Okinawa where they remained until that last island before Japan was secured. In its tour of the Pacific area the 88th used everthing from airplanes to carabao to move its men and supplies. The battalion was trained with the jeep as its organic means of transportation, but overseas everything but the jeep was used. In the Marianas it was on foot; in the Palau Group it was 1½-ton trucks; in the Philippines it was weasels, dukw's and carabao; while in the Ryukyus it was horses, 2½-ton trucks, boats and again the good old reliable feet.

The 88th claimed to be the only battalion to use the 4.2-inch chemical mortar as a coastal defense gun. In the Philippines, a landing craft loaded with between 300 and 500 Japanese was seen trying to make a landing behind our lines. The mortars were faced out to sea and registered on a narrrow channel through which the barge had to pass coming through the reef. As the ship reached that point, the mortars let loose with a crash concentration of white phosphorus and high explosive. Those not killed outright by the murderous mortar fire abandoned ship and were picked off, one by one, as they swam to the shore.

Three mortar battalions, the 82nd, 85th and 98th, were committed to the Luzon Campaign, the only period of the war in the Pacific when large-scale employment was made of the chemical battalion. These three were attached in support of eleven divisions and one separate Infantry regiment, remaining in the line an average of 165 days. They fired a total of 3,250 missions, expending 350,000 rounds of ammunition in this campaign alone.

Mortars mounted on the LCI (M)'s led the way in the assault landing at Lingayen Gulf. Then the portable mortars of the 98th Chemical Mortar Battalion, which before this assault had seen actions at Biak, Hollandia, Tanamerah Bay, Moemfoor, Aitape, and Morotai, carried the rapid fire ashore. The Luzon campaign was a rugged deal. The 98th, winching its guns over knife-like ridges in the mountains of Luzon, fought in rags for two months without a change of clothes, sleepless and weary. In the first four months of the campaign they accounted for 35 Japanese tanks, 35 mortars, 17 field pieces, 38 machine guns, 23 pillboxes, 20 ammunition dumps, 10 trucks and 7 observation posts. They fired 1,125 missions, expending 87,075 rounds of WP and HE shell, and as battle honors received 11 commendations as well as 4 Silver Stars, 16 Bronze Stars and 58 Purple Hearts.

In the first assault landings in which the LCI (M)'s provided beach protection, officers from the 88th Chemical Mortar Battalion, noncommissioned officers from he 91st Chemical Weapons Company and enlisted men from the 111th Infantry Regiment manned the sea-going automatic artillery. Tests conducted at Hawaii had proved that the accuracy of the mortar when fired from an LCI against beach targets was superior to that of the P47 plane firing rockets, the 105-mm howitzer, the 75-mm tank gun, the 3-inch anti-tank gun or the 4.5-inch rocket launcher, all of which were normally used to provide shore protection. Battle tested on a small scale at Angaur and Peleliu, Leyte and Lingayen Gulf, flotillas of the new mortar boats were readied for the great amphibious operations at Iwo Jima and Okinawa. Thirty LCI (M)'s went into Iwo Jima on 19 February 1945, their mortars manned by CWS-trained naval personnel with chemical officers of the 189th Chemical Weapons Company (Separate) aboard as advisors. The 90 mortars fixed to the decks of the LCI's fired a total of 60,000 shells into Iwo Jima in those first ten days, two-thirds of this weight covering the operations of the V Amphibious Corps over the volcanic sands during its first two days ashore.

In Marine Corps operation reports made after the battle for Iwo Jima, it was stated that the foothold on the beach might have been lost except for the terrific fire power of the boat-mounted 4.2's which prevented successful counter-attack by the Japanese.

Forty-two LCI (M)'s covered the landings at Okinawa on 1 April 1945, their 126 mortars laying down 28,000 shells alone in the first hour over an area 1,000 feet deep and 5½ miles long. These mortars could lay down a rolling barrage that moved inland as the ship came to shore, the barrage controlled by the speed of the ship. It was also possible to lay down fire within a specific area on the beach. This amounted to a series of small rolling barrages, each starting at the beach, moving inland, and then returning to the beach again. Raking an area in this manner was done by simply reducing the number of powder rings on the shell progressively as the ship moved inshore. When the mortars were fired with the ship stopped it was possible to lay down a pattern of considerable dispersion across a wide target, for a stopped ship does not maintain its position but maneuvers back and forth in maintaining its alignment to the shore.

These fierce dispensers of white phosphorus and high explosive bridged the gap between the suspension of air and naval bombardment and the establishment of artillery on the hostile shore. Naval craft and planes previously had to suspend attacks during the actual invasion operations for fear of hitting the landing troops. This lapse of time, a shrill silence after the roaring of naval guns and bursting bombs and rockets, often gave the enemy beach garrisons time to recovered from the pre-assault shellacking and reorganize their forces. The amphibious 4.2's prevented this.

In mid-1943 the first noncommissioned officers from the CWS Replacement Training Center at Camp Sibert, Alabama, left to go to the China-Burma-India theater, there to train Chinese trops in the operation of the 4.2-inch chemical mortar. Early in 1944 the 2nd Heavy Mortar Company (Chinese) was ready for the field and was attached to the 50th Chinese Division in Northern Burma. This was the only Chinese Chemical unit as large as a company to operate until 1945. Meanwhile Chinese squads of one officer and five enlisted men already trained in the use of the 81-mm mortar, were being trained with the 4.2. These men were selected from Chinese Seventh Army personnel for the specific purpose of providing the sole support available to Chinese guerrillas of the First Advanced Column operating in China's Yellow River area. By VJ-Day a score of these special squads had been trained and parachuted behind enemy lines to provide the mobile artillery of the guerrilla forces.

That was the 4.2 in World War II. A total of 25 mortar battalions and two separate mortar companies had gone into battle, although a few of the battalions had been activated at a relatively late date and so saw little or no action. Chemical Mortar Battalions had fought in every theater, supported

every type of ground combat troops and had seen extended service in the most bitterly contestd actions of the war. Also, on the basis of "days in line" in relation to the total time spent in the theaters, these battalions built up a record which is exceeded by few, if any, other organizations in the Armed Forces. More than half of the battalions had earned the coveted Presidential Unit Citation by the end of the war.

With the end of hostilities, all of the units were deactivated with the exception of the 91st which was stationed at Fort Lewis, Washington, and later transfered to the Army Chemical Center. Early in 1949 the 91st was redesignated the Second Chemical Mortar Battalion and as such it was sent to Korea soon after the invasion of the 38th parallel.

Once again the Second encountered terrain that was ideal for mortar operations and once again it found itself in constant demand for Infantry support. Although fighting in a non-toxic role, the battalion has been engaged in some of the heaviest fighting in its long and honorable history. The men of the 2nd were the first Americans to engage the Chinese Communists when they entered the conflict in November, 1950, near Unsan. (See "Chemical Mortars in Korea," by Lt. Col. Edgar V. H. Bell, page 14, July 1951 issue of Armed Forces Chemical Journal.)

Although the Chemical Corps personnel serving with the mortar units have been the 4.2's most fanatic "fans" they have also been its severest critics. They have realized the weapon's shortcomings, and many of the developments that have gone into the new M30 have resulted from comments by battalion officers.

Colonel James H. Batte, now serving as Overseas Liaison Officer in the Chief's office and who led the 87th Chemical Mortar Battalion ashore at Utah Beach on D-Day as a lieutenant colonel, was among the officers who saw the need for a swivel-type baseplate.

In June 1944, just a few days after the landing in Normandy he wrote to Major General William N. Porter, then the Chief of the CWS: " . . . . . From all units and all ranks we have received praise and admiration and no end of amazement at the job this battalion has done. (The battalion had its guns in action within ten minutes after landing.) We have been unusually successful in placing fire at critical points within a very few minutes after the supporting unit called for same. This quick adjustment has saved the Infantry many times against counterattacks and suddenly discovered gun positions. Our forward observers, operating with the leading Infantry units, have time and again observed and brought fire to bear on counterattacks and have thrown them back with terrific casualties even before our supporting Artillery could drop a round into the desired sector. This constant and continual movement and shifting about and changing of emplacements, in order to obtain increased traverse, has put a terrific strain on the men and equipment. However, much to my amazement, the men are standing up much better than some parts of the equipment. A mortar which can traverse 360 degrees without having to move the baseplate is sorely needed. We need increased traverse in order to eliminate having to move the baseplate when the next mission is in a different sector."

Today's new M30 has that 360-degree baseplate as a result of such comments as this.

The integration of the mortar battalions into the Infantry was not an over-night decision. It has resulted from a problem that has been evident since the first chemical mortar battalions went into action. The 1947 adoption of the 4.2 as integral piece of equipment in the heavy weapons company of each Infantry battalion merely increased the complexity of the situation. Being separate units with a peculiar type of mission, the chemical mortar battalions were generally split up into smaller units and shifted from place to place, attachment to attachment, as the need for the 4.2's type of fire power arose. There was no clean-cut policy on their use by the various units the Chemical mortarmen supported, and administra-

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tive and tactical control seemed to bounce from Army and Corps commanders to Division and Regimental commanders like a rubber ball.

Again we cite a quotation from Colonel Batte's letter: " . . . . . My experiences of the past 20 days have caused me to reach the conclusion that the employment and handling of a unit such as this one is, to a large extent, a question and matter of the personalities of the individuals involved; that is, from the Corps Commander on down. Each Infantry Division, Regimental, and Battalion commander has employed us differently. Already we have operated with five divisions. In every case we have been able to adjust ourselves to each one's tactical plans and desires, and have furnished necessary fire support on time, in sufficient volume, and at the place desired; which, after all, is the payoff."

The role of the chemical mortar battalion in Korea has been extremely rough, especially on this matter of attachments to various units as supporting fire. The Second Battalion has been used especially to lend fire support to the United Nation's forces which do not have organic artillery of their own. As such, the battalion has supported the front-line units of nearly a dozen different countries including our own forces, and the British, Turkish, Belgian, ROK and Dutch, mainly.

The Army's Office of the Chief of Military History is preparing a special volume on the problems of the small unit commander. Some of the letters written by Lt. Col. Edgar V. H. Bell, who took the Second into the Korean fray as its commanding officer, to General Bullene and other staff officers will be used in the volume. They were recently printed in the Combat Forces Journal and are being re-printed in this issue. Here are a couple of points Colonel Bell has mentioned:

"After a rough night, I gathered up the pieces and reformed the battalion. We were immediately attached to the 27th British Commonwealth Brigade, this making our fifth attachment in 25 days. That's enough, in itself, to drive a battalion commander stark mad.

"We joined the British and have been with them ever since. I am happy with this attachment. These people know their business; they know heavy mortars." (For the British view of the Second Chemical Mortar Battalion's battle rating see the boxed insert, page 16, "Chemical Mortars in Korea" by Lt. Col. Bell, Armed Forces Chemical Journal, July, 1951).

"We have been the covering force for IX Corps since the retreat (November-December 1950) and the battalion constitutes the light artillery for the brigade. We have not yet been able to obtain any replacements of our equipment losses at Kujang-dong by legal means, but as we are the rear guard of a retreating army, we have picked up some gear. . . . .

"I also feel that chemical mortar battalions should not be sent to any theater as chemical mortar battalions unless the use of toxics is contemplated. The personnel may be sent as filler replacements or the mortar companies may be sent out as heavy mortar units but there just is no slot for a chemical battalion except where chemical munitions are to be used.

"This present attachment is by far the best one we have had. The 27th Brigade has no heavy mortars and we fill the gap between their own 3-inch mortars and the direct support artillery, thus bring the brigade's fire power to nearly that of one of our regimental combat teams. We have an important slot to fill, but when we are attached to an American division—and we have supported four of them—we are used only to reinforce the fires of their own heavy mortar companies. I have had to fight hard to keep our companies from being attached to the organic mortar companies. This is a waste of firepower, and worse still, a waste of manpower. A separate mortar battalion has no role in the present army organization except in the case of gas warfare."

Colonel Bell's dilemma was nothing new. His thoughts had been said many times over during the days of World War II by chemical mortar battalion officers, as they saw their unites

split and distributed over the wide fronts. However, the incongruous situation has now been solved.

When the Infantry colonel muttered "impossible" back in the mid-twenties after seeing the 4.2 in operation he was merely setting the pace for the future comments.

As late as April 1950, the terms "impossible" and "impractical" were being applied to the 4.2 mortar. A national magazine was queried by a reader who wanted to know if there was such a thing as a muzzle-loading, rifled-barrel weapon. The magazine printed a reply that such a piece would not only be "impossible, but also impractical." The editors of the magazine were swamped with letters refuting their claim and a later issue of the magazine carried a retraction. However, the editors never did accept Colonel Bell's invitation to attend a demonstration of the 4.2 by the Second Chemical Mortar Battalion at the Army Chemical Center.

Battle records of the mortar units are filled with examples of non-believers becoming the staunchest supporters of the "little gun with the big wallop and pin-point accuracy."

Extracting at random from the files of the Historical Office we'll quote from a letter written in July 1944. The letter was sent to the Chief's office by Captain John B. Lynch, who at that time was serving with the 86th Chemical Mortar Battalion.

Captain Lynch wrote: "One battalion commander (Infantry) who had never had any attached 4.2's called down to the mortar position on the first day our platoon was attached and said, 'I'd like to get some idea of your weapon. Can you fire a few rounds at RJ such and such?' He gave the co-ordinates. One round of WP was fired to register in. As soon as it had landed, the Battalion CO called back . . . . 'I've seen enough' . . . . We learned later that the round had landed in the middle of the intersection."

Another example of the accuracy of the 4.2 was cited in the same letter from Captain Lynch, when he wrote: "Another (mortar) company was asked if they'd like to try having a Cub observation plane direct their fire. They agreed immediately and were told to fire twenty rounds at a house that had been a trouble spot. The air observer called back 'first round on target'. They were instructed to fire five more rounds. They fired three, checked the mortar for possible settling, then fired two more. The observer came back . . . . 'All six rounds on target'. They didn't bother to fire any more."

Such shooting could possibly be considered mainly a matter of luck. However, the record book contains too many instances of such pin-point accuracy to let Lady Luck take all the credit. And certainly, any soldier who has worked with the 4.2 will start citing examples "at the drop of a hat" to prove that the reputation of the 4.2-inch chemical mortar is based more on fact than luck.

Without a doubt the events of the past ten years have tended to more than confirm the prediction made by Captain McBride as early as 1925 that "One 4.2-inch Chemical Mortar, accompanying the Infantry, can in the same time, deliver over six times as much high explosive, smoke or gas as the 155-mm. gun or howitzer, and over nine times as much as the 75-mm. gun, up to a range of 2,500 yards in front of the Infantry." Possibly Captain McBride was marked down as a "radical" when he made this prediction; however, the record of the 4.2 in World War II and Korea has shown that he had plenty of foresight.

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THE 4.2-INCH MORTAR IN KOREA

REPRINTED BY PERMISSION FROM THE COMBAT FORCES JOURNAL, DECEMBER, 1952.

LETTERS FROM THE COMMANDER OF A CHEMICAL MORTAR BATTALION IN KOREA TO THE CHIEF OF THE CHEMICAL CORPS

These letters by Colonel Bell were furnished to the Chief of Military History by General Bullene and are published with the permission of both General Bullene and Colonel Bell. They have added interest at a time when the 4.2-inch mortars are being transferred from the Chemical Corps to the Infantry.

Hq. 2d Cml. Mortar Bn
APO 301 c/P.M.
San Francisco
13 November 1950

DEAR GENERAL BULLENE:

I wrote to Colonel Efnor [Lt. Col. Sam Efnor, Jr.] the other day and told him of the activities of the battalion and asked him to pass this information on to you. There is not much to add at present. We are now with U.S. troops on the offensive again, and the battalion is doing very well.

I have been promised some new mortars and when we get them the entire battalion will be in action. We have had a great deal of breakage of mortar parts—elevating screws and traverse nuts are the principal ones. Replacement parts that we brought from Edgewood Arsenal are nearly exhausted and there are no other 4.2-inch mortar parts in Korea.

I have not permitted fire over 4,000 yards. It has been extremely difficult to keep the mortars in range. There are no roads as we know them, only narrow cart trails barely passable (one way) by jeep—and then only in dry weather. These cart tracks are nearly always raised well above the surface of adjacent rice paddies. Once a vehicle is off the trail it is nearly always bogged down for good. Tremendous frontages assigned to infantry units require us to do a great deal of rapid movement so hand-carry is entirely out of the question.

Ammunition has been a terrific problem but so far we have never had less than 100 rounds per mortar on position. This requires great effort and much truck movement as supply lines are very long in point of hours of travel.

I am operating a very small forward command post. I have with me the S3, the assistant S3, the S2, communications officer, and surgeon—together with 22 enlisted men. The rest of headquarters company, under Maj. [Merritt W.] Briggs, is about 20 miles to the rear where they can work in comparative calm and comfort. This has many advantages as the administrative personnel can settle down in one spot and stay there for a week or more while we move nearly every day. The small detachment up here can move quickly and does not clutter up congested trails. For security we tie-in to some nearby infantry battalion or regimental command post when we stop for the night.

If any other chemical units come over here they should bring additional tentage. We have very little and there is no shelter available. The few buildings are pre-empted by higher commands, leaving only open fields for people like us. It is bitter cold and, though the battalion has drawn special winter clothing, the men still suffer because there is no shelter. A couple of squad tents in each company rear would be worth their weight in gold.

I keep the company rear echelon near to me. This consists of their mess truck, supply truck and motor maintenance truck—with the personnel from these sections. The battalion sees to all supply of ammunition, rations and POL. We feed two hot meals and one C ration meal to the forward units. However, a few of us who are constantly on the move rarely have anything but C rations. The kitchen crews must be able to bake good bread for there are no bakeries over here.

Personal cleanliness is difficult as there are no laundries or shower points. The country is crawling with lice and fleas. I require frequent foot inspection as I am most fearful of trench foot.

We are fighting mostly against the Chinese now as the North Korean units are broken badly and fight principally as guerrillas. The Chinese are well equipped with small arms, automatic weapons, and mortars. The Chinese usually attack down draws and bottoms and in covering these approaches, our mortars have done their best work. The Chinese take terrific losses but they keep on coming. Our mortar men get into frequent small-arms fights.

We certainly need the new M30 mortar badly and have hopes of receiving it one of these days. If I had only one in each company it would be useful in reaching the 120mm mortar used by the Chinese. Their mortar has a range of 6,500 yards and they can sit back and plaster hell out of us while we are out of range. The best anti-mortar weapon is another mortar.

There is much more that I could tell but I have so little time. The morale of the battalion is very high and the men are full of fight, wishing to avenge our losses at Unsan. We do not really need anything here except 36 mortars and three or four more mortar battalions equipped with this new weapon.

Very Sincerely Yours,

E. V. H. BELL
Lt. Col., CmlC

16 December 1950

DEAR GENERAL BULLENE:

Following the withdrawal of all United Nations forces to the Chongchon River in November, the battalion was attached to the 5th Infantry, 24th Infantry Division, and rushed to Kunu-ri. The 24th Division was relieved by the 2d Division and we shifted to that outfit.

Since the withdrawal from Unsan, the battalion has been committed and shooting every day. We had Company C intact with all three platoons, and Company B with two platoons. Company A, having lost or destroyed all of its mortars and nearly all of its other equipment, was out of action.

Early in November as things were not too rosy, I sent our administrative section back to Sukchon. I reinforced Companies B and C with officers and men from Company A. Refitting Company A was a terrific task as we had to go all the way back to Pusan for the vehicles and most of the

equipment. Efforts to have corps or army re-equip us were unsuccessful. Only aggressive and hard driving action on the part of Capt. [Clair L.] George, battalion S4, and his assistants got us our equipment. They went to Pusan, drew the trucks, loaded supplies, and then drove them more than 450 miles over the world's worst roads.

We were able to replace only half of our losses in vehicles and even less of the communications equipment. I completely reorganized the battalion while in the lines and redistributed personnel and equipment to have Companies A and B each with three platoons. We had Company A back and shooting just two weeks to the day after they were knocked out.

When the drive started about Thanksgiving, we were attached to the 9th Infantry Regiment, 2d Infantry Division. We had pushed northeast to a point a few miles north of the town of Kujang-dong when the Chinese hit us again. The 9th RCT was badly cut up as was part of the 38th RCT. Company C was overrun and initially we got only four jeeps, one officer and 24 enlisted men out of the mess. Later most of our personnel either drifted back or were located in clearing stations. I sent the survivors back to our rear which I had just moved to Kunu-ri. We kept Companies A and B in the fighting and it was hot.

The next day the Chinese hit again and the big retreat started. We pulled out with what was left of the 2d Battalion, 9th RCT, the last to leave. They had 274 officers and men and we loaded them on our vehicles. We retreated to Won-ni where we put up a road block which lasted just two hours. It was about 0330 when the infantry battalion commander reported to me that he had only 30 men left of the 274, so we all pulled back to Kunu-ri. We went into position there and the following night, at about 1900, received an order to pull out—saving what we could but destroying any equipment we could not get out. At the time we received our march order, we were firing at a range of 700 yards. We lost only one jeep trailer, which upset and was burned.

After a rough night, I gathered up the pieces and reformed the battalion. We were immediately attached to the British 27th Commonwealth Brigade, this making our fifth attachment in 25 days. That's enough, in itself, to drive a battalion commander stark mad.

We joined the British and have been with them ever since. I am happy with this attachment. These people know their business; they know heavy mortars.

We have been the covering force for IX Corps since early in the retreat and the battalion constitutes the light artillery for the brigade. We have not yet been able to obtain any replacement of our equipment losses at Kujang-dong by legal means, but as we are the rear guard of a retreating army, we have picked up some gear. Our S4 with a party of 35 men is now in Pusan and I hope to see them back here tomorrow with enough equipment to place Company C back into action with two platoons.

We could not operate more than eight mortars per company no matter how much equipment we had, for our strength is down to 23 officers and 352 enlisted men. I have cut headquarters company down hard in order to get a hundred officers and men in each of the letter companies. But even to operate only eight mortars the "bread is sliced mighty thin" and most men have two jobs to do.

While I feel horrible over the loss of so many fine officers and men, it is a little comforting to know that we lost them while fighting, not while retreating. Company C, for example, knew that they were being swamped but they fired defensive fires at 600 yards and had only ten rounds left in the company when the last rush hit. They were able to destroy eleven of their twelve mortars. The Chinese got to the vehicles first, as usual.

Very Sincerely Yours,

E. V. H. Bell
Lt. Col., CmlC

31 December 1950

Dear General Bullene:

We are still attached to the British 27th Brigade and have 24 mortars in action with a total strength of 338 enlisted men and 23 officers. Of the 33 chemical officers who left Edgewood Arsenal with us, only 19 are still here. Of the fourteen who have left, five are missing in action, two are wounded in action, four hospitalized for non-combat causes, and three have been transferred. None of the four hospital cases will be returned within 90 days. This leaves us pretty short-handed both for officers and enlisted men, but we are doing all right.

You will be interested to know that we have never been withdrawn for reorganization nor have we received any enlisted replacements. We have received four officers since we were committed. Unfortunately these officers knew nothing of mortars and damn little about combat troops. We lost one officer within three weeks, and it was a shame—like sending a lamb to slaughter.

I feel very strongly that if the Chemical Corps is to continue to have chemical mortar battalions, it should procure and train the correct type of combat officers for this duty. I would not give a tinker's damn if such an officer did not know one end of a test tube from another, but I would insist that he have a thorough knowledge of infantry organization, tactics, and weapons. I would not care about college degrees if the officers had the will to fight.

I also feel that chemical mortar battalions should not be sent to any theater as chemical mortar battalions unless the use of toxics is contemplated. The personnel may be sent as filler replacements or the mortar companies may be sent out as heavy mortar units but there just is no slot for a chemical battalion except where chemical munitions are to be used.

This present attachment is by far the best one that we have had. The 27th Brigade has no heavy mortars and we fill the gap between their own 3-inch mortars and the direct support artillery, thus bringing the brigade's fire power to nearly that of one of our regimental combat teams. We have an important slot to fill, but when we are attached to a U.S. division (and we have supported four of them), we are used only to reinforce the fires of their own heavy mortar companies. I have had to fight hard to keep our companies from being attached to the organic mortar companies. This is a waste of fire power, and worse still, a waste of manpower. A separate mortar battalion has no role in the present army organization except in the case of gas warfare.

We are in pretty good shape. Morale is high, and while the weather is bitter cold, our men are well equipped for it and can get along.

Very Sincerely Yours,

E. V. H. Bell
Lt. Col., CmlC

12 January 1951

Dear General Bullene:

We are still in support of the 27th Brigade. With them, we were the last troops out of Seoul.

I do hope that one more effort will be made to award our people the Combat Infantryman Badge. It seems to me to be rank discrimination to keep this badge from our men simply because of the word "chemical" in our unit designation. The men in the heavy mortar companies of infantry regiments serve the same piece, fire the same ammunition, and are subject to the same hazards as are the men of our battalion. Frequently in Korea, the infantry heavy mortar companies have been attached to my battalion for operational control. Of course, when this was done, the more dangerous assignments were given by me to our own companies.

It is common practice for us to operate jointly with the infantry heavy mortar companies' forward observers, fire direc-

(Continued on Page 55)

—U.S. Army Photo

A ball of livid flame covers the explosion area as the simulated A-bomb is exploded.

—U.S. Army Photo

Within a matter of seconds a heavy cloud of smoke starts to rise into the air.

—U.S. Army Photo

A gaping hole is all that is left at "point zero" while above towers the familiar mushroom-shaped cloud of smoke that signifies an A-bomb.

MOCK A-BOMBS

Courtesy of the Chemical Corps

Troops undergoing training at Fort Jackson, South Carolina, recently got a realistic, although simulated, view of the effects of an atomic bomb blast, thanks to the ingenuity of a Chemical Corps officer.

Throughout the Army, all troops are undergoing training in defense against radiological warfare. The troops of the 8th Infantry Division at Jackson are no exception. When this training program got underway, Captain Bernard F. Allen, Post and Division Chemical Officer, was faced with the problem of "how to make the training more realistic."

Remembering the reaction of soldiers who had witnessed the real A-bomb explosion at Yucca Flat in Nevada last April, he began work on a mock A-bomb blast that would be safe and economical. With the assistance of PFCs Charles Gunthorpe and Joseph MacMillan, Capt. Allen came up with an imitation atomic blast that looks like a small edition of the real thing. Weeks of thought and work, plus five trial explosions, went in to the project before the effect was to his liking.

Now, on the sandy flats of Jackson, an average of four explosions a week are run off as each unit of the 8th Division goes through its training cycle. The trainees receive lectures on the effects, capabilities and limitations of various types of atomic explosions as they learn to protect themselves against possible enemy atomic weapons. At an appropriate hour during the radiological defense course, the trainees get a realistic demonstration of the heat and smoke pillar generated by a real A-bomb.

Detonated by means of a primer cord and blasting cap, the mock bomb bursts with an ear-shaking explosion, creating a dazzling flash of flames and a fireball which surges at its base and then rises rapidly into a partially vacuumized pillar of smoke. As the fireball cools and disappears, the characteristic, mushrooming cloud of smoke appears and retaining its form, reaches a height of nearly 1,000 feet for five minutes. At "ground zero," all that is left is a huge crater.

Just to keep the realism, the trainees are seated about 200 yards from "ground zero" in order that they may feel the blast effect with safety. Between them and the explosion are deep foxholes, filled with combustable material to bring out the emphasis on individual protection. Other combustable material is left on the ground in proximity to the explosion, and ignites readily. The comparision of this burned material with the unburned material in the foxholes makes every trainee a firm believer that "foxholes aren't just another waste of time and effort."

Capt. Allen's recipe for his simulated A-bomb includes Napalm, gasoline, waste oil, acid, white phospherous hand grenades, the contents of a smoke pot, primer cord, and a hole in the sand. All these materials are authorized for training units, thus the bomb is worked into the training schedule at no additional expense.

The fireball effect is produced by the jellied gasoline and white phosphorous, with ordinary gasoline causing the flash of light. Acid, which produces a dense white smoke when in contact with the air and waste oil are responsible for the mushrooming cloud.

The first public notice of the simulated atomic explosion was given in an October issue of the Army Times. Since then, according to Capt. Allen, he has received numerous letters from other Chemical Corps officers who are with training units. All want to incorporate his "brain-child" into their programs.

The size of the explosion and pillar of smoke can be made smaller or bigger as the need arises. To make it larger, a deeper hole is dug and TNT is added to the explosive.

In mid-November, Capt. Allen transferred to the Chemical Section, Headquarters, Third Army, Fort McPherson, Georgia.

DR. WILBER TELLS OF ARTIC EXPERIENCES

Microscopes, test tubes, and clinical thermometers might seem rather odd and unusual tools for arctic exploration but these are merely sundries to Dr. Charles G. Wilber, an unusual arctic explorer of the Chemical Corps Medical Laboratories at the Army Chemical Center, Maryland. Dr. Wilber has led five expeditions into the unexplored wastes of the arctic in connection with his research on the physiology of men and animals in the polar regions.

The arctic environment, according to Dr. Wilber, is anything but a lifeless place. Men and animals have lived there for thousands of years, but the question of how they live and the effect of this environment on their life processes opens a new frontier of science. Dr. Wilber acknowledges that life in the arctic is different. His problem has been scientific study of these differences as they occur among the native animals and men of the arctic and also the effects of arctic life on those accustomed to more temperate climates.

The arctic which long has been the last frontier for American colonization now is emerging as a frontier of national defense, both of vital interest to all Americans. Dr. Wilber has been exploring this new frontier in problems ranging from the general physiology of arctic animals to advising on diets and clothing from American troops who are or will be stationed in arctic regions.

Dr. Wilber was first introduced to the problems of the arctic while serving with the Air Force in World War II as Chief of Altitude Training and Arctic Survival for the 11th Air Force in Alaska. He established an Arctic Survival Camp where air crews were instructed on how to live under the minimum conditions of the arctic. In their final examination the fliers were abandoned in the arctic with minimum survival equipment and were required to report back at their base in from three to five days. All happily survived and became much wiser in the ways of the unfriendly arctic. This program inaugurated by Dr. Wilber has been continued as a part of the training for all fliers who fly in or over the polar regions.

Following his Air Force experience Dr. Wilber was appointed assistant professor of physiology at Fordham University. However, his interest in the arctic remained unabated and in 1949 he led the Fordham University Arctic Biological Expedition to the coast of Alaska. The cooperation of the Air Force in this and subsequent expeditions proved especially valuable in transporting the members of the expedition and their supplies overnight across vast areas of the Alaskan glaciers.

In 1949 Dr. Wilber joined the faculty of St. Louis University as an associate professor and director of the biological laboratories. This position especially appealed to him since it offered opportunity for continued exploration through the University's program of arctic research sponsored by the Arctic Institute of North America. As director of this program he has developed a system of continuous exploration and research in the arctic with four expeditions since 1949. In addition to the regular annual expeditions the arctic research program has also maintained a permanent group of researches in the polar regions which is continuously investigating the wealth of untapped information in that region.

Dr. Wilber and his associates have reported on such diverse subjects as the life processes of hibernating animals and the blood pressure and food habits of the Eskimos. The studies on Eskimos have been especially rewarding, and since the Arctic Institute employs a large number of them in its work, the opportunities for this study have been unique. Since the true Eskimo is rapidly disappearing as a primitive race this present generation is probably the last one available for study. Certainly such a study is warranted, for in Dr. Wilber's opinion, we have much to learn from these people about the regions of the far north. The Eskimos live almost solely on a diet of meat and yet from a nutritional aspect are completely healthy. A study of the older Eskimos on the northern Alaskan coast indicated that there is no tendency toward heart disease, and consistent blood pressure readings revealed better than average health. This would seem to indicate that perhaps these people have much to teach us and certainly must justify the belief that the region in which they live is a fertile field for research.

"ARKANSAS TRAVELERS"

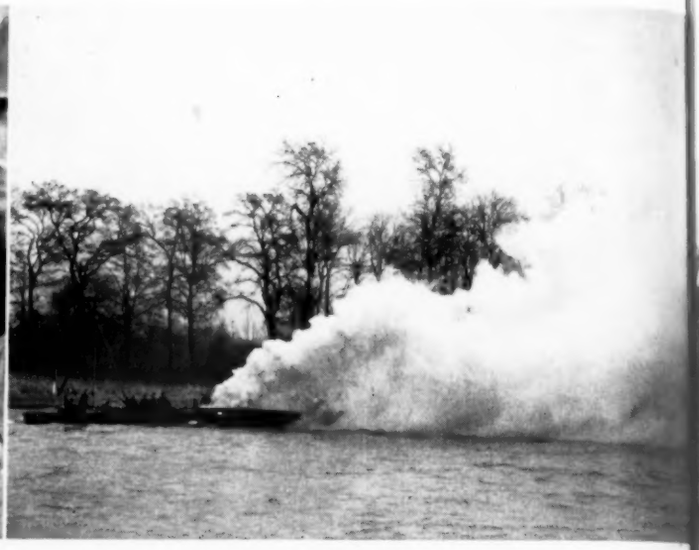
Shown after being named "Arkansas Travelers" by Governor Sid McMath are Lt. Col. John J. Hays, Commanding Officer of Pine Bluff Arsenal, and Lt. Col. E. A. Limbaugh, assistant for depot operations, at the Pine Bluff installation. From left to right are: J. Milton Howard, Pine Bluff, Col. Hays, Governor McMath, Col. Limbaugh, and Thurman McCool of Pine Bluff.

THE CHEMICAL CORPS ON WORLD

—U.S. Army Photo

KOREA

Cpl. Paul L. B. Ayres of Cape Charles, Va., is congratulated by Brigadier General Kenneth S. Sweany, Artillery Commander for the U.S. X Corps, after having received the Bronze Star medal for meritorious service in action, during ceremonies at the Headquarters, 2nd Chemical Mortar Battalion. The battalion has since been ordered converted into an Infantry Heavy Weapons Bn. The above photo was taken on a day when 25 members of the battalion received medals, to maintain the unit's fame as one of the most decorated outfits in Korea.



GERMANY

The 379th and 411th Chemical Smoke Generator Companies of the 451st Chemical Smoke Generator Battalion, in an effort to determine the best methods for use in the water operations of smoke generators, hold a smoke screen test on the Rhine River near Karlsruhe with the aid of the 317th Engineer Pontoon Bridge Company. A pontoon bridge was used to carry the smoke generator equipment out upon the Rhine River where it was put in operation and a successful smoke screen producd. The pontoon was loaded with the equipment at the Rhine River Patrol Base at Karlsruhe and towed on the water by a small power boat of the 317th Engineers. The men lay down a smoke screen on th Rhine River from pontoon bridge section pulled by a small power boat of the 317th Engineers.

CAMP McCOY, WISCONSIN

Two flame-thrower teams demonstrate their equipment during a firing demonstration held at Camp McCoy, Wis., on Armed Forces Day.

JAPAN

Left, top: Aerial view of smoke screen laid down by members of the 453rd Chemical Smoke Battalion during maneuvers at Shinodayama, Japan.

KOREA

Left: A Tank uses a flame thrower on a Chinese Communist pillbox deeply emplaced in the ground in the Han River Area.

WIDE FRONTS

—U.S. Army Photo

FORT BENNING, GEORGIA

There's a new look to the old 4.2-inch mortar since it left the care of the Chemical Corps. A longer barrel, recoil springs, attached sights, and other modifications have changed the old "pride and joy" into a better Infantry support weapon. In the above photo Pierre De Chevigne, Secretary of the French Army, looks over the shell of the "modernized" mortar at Simpson Range, the Army's first electronically operated firing range.

OKINAWA

Sfc. Alto W. Adams of Newark, N. J., 71st Chemical Smoke Generator Company, performs an operational check on one of the many smoke generators his unit maintains. 29 January 1952.

FRANKFURT, GERMANY

Cpl. D. E. Griswold Chemical Section of the 4th Division Headquarters Company, showing the Lebanese Officers the flame thrower. Left to right: Lt. Col. Nu Jaim, Lt. Col. Labski, Col. Simaan, Capt. Jabour of G-2 Division; Cpl. Griswold, and Col. Shehab. An American officer, Lt. Col. Lawlor, is with them.

FORT SAM HOUSTON, TEXAS

Right: Captain Ruth M. Miller, Medical Corps, the fourth woman doctor to be commissioned in the Army since World War II, donning a gas mask preparatory to entering the tear gas chamber used in the basic training course for newly commissioned officers.

Tech Escort Detachment's Museum of Chemical Warfare.

GENERAL BLACK

THE MATERIEL COMMAND

By LT. JAMES A. JORDAN, JR.*

In October of 1951 a huge decentralization program was undertaken by the Chief Chemical Officer, Major General E. F. Bullene. As a result of this decentralization the Chemical Corps was divided into three major commands with missions as designated by the Chief.

The mission of the Chemical Corps Materiel Command was established as follows:

The Chemical Corps Materiel Command will have operational responsibility for, and direct command over, all Chemical Corps manufacturing, supply and procurement installations and activities. The Commanding General, Chemical Corps Materiel Command will exercise command jurisdiction over and be responsible for direction and execution of the programs of Chemical Corps pertaining to: (1) the procurement, production, inspection, receipt, storage, issue, disposal, and maintenance of Chemical Corps supplies and equipment; (2) the acquisition, leasing, construction, maintenance, and disposal of all Chemical Corps facilities related thereto; and (3) responsibilities at manufacturing installations formerly assigned to the Chief Chemical Officer.

Essentially this means that the Materiel Command has been delegated lots of hard work. The United States has learned that basically the work of winning a war is started way back in Kokomo or Dawson or Baltimore or any other city which has a factory, large or small, that can produce materials of war. The Materiel Command has most of its work done in these factories.

Authorities say the Germans didn't initiate gas warfare in World War II because they believed the United States was better prepared to use gas than they were. It is one of the functions of the Materiel Command to see that any future enemy labors under the same correct impression.

This vast procurement and distribution agency necessitated by the demands of modern war is headed by Brigadier General Henry Maris Black. Its headquarters is in Baltimore, Maryland.

General Black was born at Saint Helena, California, May 29, 1894, the son of John M. L. and Lydia K. Black. He attended prep school at Haverford School, Haverford, Pennsylvania and later went to Pennsylvania State College for one year, where he took engineering as preparation for his entry into the United States Military Academy.

He graduated from West Point in 1917 and was immediately commissioned second then first lieutenant in the United States Army. Since that time he has attended the Chemical Corps School and the Army Industrial College, where he was awarded the army's highest educational degree. In 1929 he went to Harvard and earned a Masters Degree in Business Administration.

General Black has been intimately acquainted with the manufacturing, fiscal, procurement, and supply matters of the Chemical Corps since his entry into the Corps in 1921.

*Lt. Jordan is the Technical Information Officer for Headquarters, Chemical Corps Materiel Command.

Tank flame-thrower in operation showing use and potential of main-armament flame thrower.

In 1940 he was named chief of the production division at Edgewood Arsenal, Maryland. He organized and was in charge of arsenal operations in 1941. In 1943 he took over as chief of arsenal operations at Pine Bluff, Arkansas. 1945 saw his shift to Camp Detrick, Maryland as the post commander. From 1946 to 1949 General Black served as the chief of supply and procurement in the office of the Chief Chemical Officer. From 1949 to 1951 he was assistant chief chemical officer for materiel in the Office of the Chief.

General Black gained two promotions during World War II, lieutenant colonel in 1940 and colonel in 1942. He became a general on 28 July 1951.

The General includes among his decorations the Legion of Merit, Army Commendation Ribbon, the World War I Victory Medal, the World War II Victory Medal, and the Army Defense Medal.

Although the Materiel Command was established on the 15th of October 1951, it was the 28th of October before General Black was formally appointed the Commanding General of the Chemical Corps Materiel Command.

General Black divided his command, which is responsible for the procurement of all chemical warfare materiel for all the services, into three operating divisions. The Industrial Division, which directs procurement and manufacturing; the Supply Division, which takes care of storage, maintenance, and distribution; and the Inspection Division, which directs field inspection activities and assures that supplies procured, stored and delivered meet the necessary quality standards.

The Industrial Division has under its supervision six procurement districts. These districts have offices in New York, Boston, Dallas, Chicago, San Francisco, and Atlanta. They are obviously located strategically to cover the country.

There was a time when the Chemical Corps did its procurement by hiring different contractors to assemble items after it had furnished all the various parts and materials. This caused the army to duplicate somewhat the costly and trained purchasing, inspection, and engineering personnel already operating in industry. In an effort to eliminate unnecessary costs, The Chemical Corps switched to end item procurement.

This type of procurement simply means that the Chemical Corps now contracts much as any other business firm. They want a certain object, and they pay some company to produce it. That way the contractor procures his own parts and materials.

The various procurement districts operate as the buying agents for Headquarters Materiel Command. The districts keep a sensitive finger on all their contractors and on all potential contractors. They must know who produces what and how, for with them rests the responsibility for placing contracts.

When an order comes from the Air Force or Department of the Army or from any other ordering agency to the Materiel Command, it is referred to the Industrial Division which in turn sends it to the appropriate procurement district.

One function of the procurement districts is to see that the item is obtained as economically as possible. In order to accomplish this, contracts are normally let on an open bid basis. However, every procurement district has an individual to look after small businesses. These small business specialists do everything within their power to aid the small businessman.

Another agency under the Materiel Command and closely related to the various procurement activities is the Chemical Corps Procurement Agency (CCPA) at the Army Chemical Center, Maryland.

The CCPA has as its primary mission the procurement of research, development, and service type contracts. It is also responsible for the local procurement needs of the Army Chemical Center.

The essential difference between the contracting of CCPA and the procurement districts is that the procurement districts buy items chiefly for issue to the Army, Navy and Air Force, whereas the CCPA buys items and services needed by the Chemical Corps research program.

CCPA contracts with universities, large manufacturers, and research stations for special projects desired by the Research and Engineering Command. Their special contracts include

Repair of portable flame thrower in process at Eastern Chemical Depot.

Renovation of flame thrower taking place at Eeastern Chemical Depot.

such things as research for a streamlined metals analysis process, a re-design of gasmasks, tests of protective clothing, and design for a 1/10 horsepower motor. They contract for any service needed or desired by the Chemical Corps.

The Materiel Command also has under its command three arsenals: Edgewood Arsenal at Army Chemical Center, Maryland; Pine Bluff Arsenal at Arsenal, Arkansas; and Rocky Mountain Arsenal at Denver, Colorado.

The arsenals do most of the Chemical Corps' munitions manufacturing. The procurement districts furnish the arsenals with parts and materials and the arsenals do the assembly. The arsenals receive empty shells and shell bursters and load them with toxic agents, white phosphorus, smoke filling, and other chemical agents.

Under the Supply Division of the Materiel Command are three depots—Eastern Chemical Depot at Army Chemical Center, Maryland; Midwest Chemical Depot at Arsenal, Arkansas; and Deseret Chemical Depot at Tooele, Utah—and the chemical sections of five of the army's general depots—New Cumberland, Utah, Atlanta, Memphis and San Antonio. Supply is charged with the responsibility for getting Chemical Corps weapons, equipment, and munitions to the troops.

However, Supply is not called on to actualy deliver the item to the individual soldier. The Supply Division collects all the chemical items produced over the country and stores them in its various depots. From the depots the items are sent to the overseas theaters and the posts, camps, and stations in the United States as they are requested. Normal supply channels must get the item from army and command level to the soldiers.

It is Supply which takes the orders from the other services and which keeps current information on the troop needs of the army. Theirs is the problem of storing the dangerous and bulky items until such time as they are needed. They must also have all the necessary items for defense against chemical, biological, and radiological warfare stored at points strategically located for rapid distribution.

Gas masks, incendiary bombs, white phosphorus grenades, protective clothing, protective ointment, smoke pots, smoke generators, flame throwers and many other items are among those kept in the chemical depots ready for use.

Supply has a depot maintenance responsibility to insure that all items stored by them are maintained in useable condition. They also store and issue items for the Air Force, chiefly incendiary and napalm munitions. All the incendiary and burning munitions used by the Air Force are furnished by the Chemical Corps.

To indicate the constant state of readiness in which Supply is and must be kept, the chief of the Materiel Command's Supply Division had this to say. "We are prepared to meet any demand anywhere—provided adequate transportation is available. Our only limitations are transportation and the country's productive capacity." Comforting words from what may well be one of our most important divisions in an all out modern war.

Supply also has under its control a small troop unit known as the Technical Escort Detachment. This detachment is stationed at the Army Chemical Center, Maryland. Their mission is to guard and escort transportation of certain agents or munitions. Growing out of this primary mission the Tech Escort Detachment has developed considerable skill and efficiency in the fields of decontamination and demolition. The Tech Escort group is now staffed with many experts in the field of handling and disposing of toxic chemical, biological, and radiological munitions.

To the Inspection Division falls the task of being the watchdog of quality. Thus, this organization develops the necessary inspection policies and inspection directives. These directives must be written to apply to the plants of both small and large manufacturers. Above all the Inspection Division must assure that strict control over quality is exercised at all times during the conversion of raw materials into the finished product. Rigid requirement of military specifications must be met.

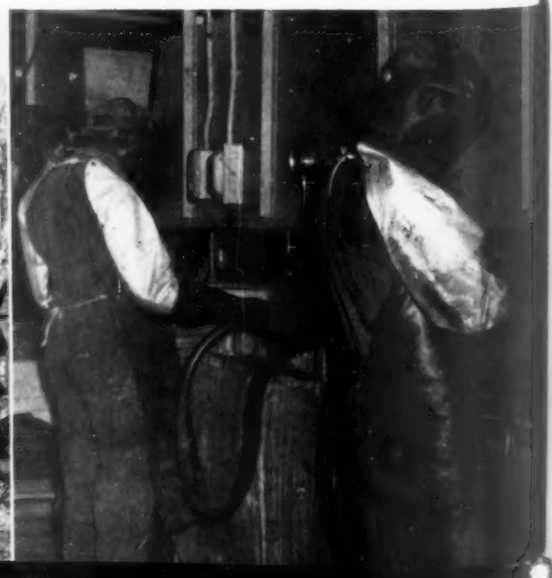
Inspection provides for the development of procurement and surveillance inspection directives. The procurement directives deal with the problems encountered by the inspector assigned to procurement districts, and the surveillance directives cover the problems encountered after supplies have been accepted into the supply channel. The Inspection Division must also see that all inspection activities are adequately supplied with special inspection equipment. This special equipment may be a simple gauge or it may be an airplane. No matter what it is, if the inspector needs it, the Inspection Division furnishes it.

The inspection task ranges from routine and repetitive jobs to exhaustive investigations; however its importance cannot be underestimated. While inspection's job may seem dull and monotonous it is the only safeguard between life and death in many cases. Consider the possible effect of a faulty gas mask, defective grenades, or other substandard equipment. The Inspection Division therefore shares the responsibility for seeing that our troops get the best equipment available.

Altogether the Materiel Command, with its three divisions, makes up a small part of the Army team. Not the part of the team with the angry scowl and the blood and guts and glory written in its past, but the part with the straining muscles and sweat and long hours of arduous labor as its record. It takes both parts to win.

Workers on the white phosphorus shell-loading line, loading W P into shells, Pine Bluff Arsenal.

Tech Escort Detachment engaged in its demolition and salvage work.



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Lead Stearate (for ammunition) (JAN-L-758)
Copper Naphthenate (for many mildewproofing specifications)
Drier, Paint, Liquid (TT-D-651a) Type I and Type II
Drier, Naphthenate, Concentrated, Liquid (Navy 52-D-7) (AN-TT-D-643) Type I, Lead 24%; Type II Cobalt 6%; Type III Manganese 6%; Type IV Zinc 8%
Linoleate, Manganese (MIL-L-15188-Ships)
Resinate, Calcium, Type I (USA-50-11-896)
Resinate, Manganese (Navy 52-R-8a)
Resinate, Sodium (MIL-S-6138-Aer.)
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ACC's CHEMICAL CORPS MUSEUM DISPLAYS LARGE, VARIED COLLECTION

By SGT. ZACHARY JAQUETT

Throughout the length of the low still rooms in buildings 1350 and 1358 at the Army Chemical Center, stand rows of unusual objects, many of them of highly intriguing design. Here are the products of chemical warfare, some of them designed to kill and maim while others, in sharp contrast, indicate the results of extensive research, undertaken to counteract and prevent such tragedy.

None of the creations displayed here will ever do more than exhibit their respective killing and curing abilities, for they are simply on display in a museum—the Chemical Corps Museum of the United States Army.

At present 7,655 items of chemical warfare and defense are shown here. Equipment dating from 1900 to the Korean conflict illustrates the many different avenues of research in chemical warfare. Thus the museum's value becomes clear. As a center for assembling and displaying chemical warfare materials it performs an invaluable service in preserving them for exhibition and reference purposes, thereby assisting immeasurably in preventing duplication of previous work and serving as a perpetual guide for new developments.

Although its purpose is plain, the museum has had an interrupted history. Initiated in 1922, it was dropped and revived twice in the interim, finally being reestablished in 1950. Since its inception the museum's collection has gradually expanded, each new acquisition increasing its educational value and interest.

Throughout the museum's checkered career, however, the thousands of objects have been preserved until today the extensive collection is historically irreplacable. Indeed its significance is world wide, for the American Army is not the only one that has done this type of research. Many other nations, notably Germany, have made important contributions to the furtherance of chemical warfare.

This country's ample research and interest made, in 1946, a tremendous contribution to the museum's collection. During the closing days of World War II the Nazi's Gas and Defense School at Celle, Germany, was captured by British troops. For some reason the English expressed a desire to destroy the school's museum completely, but with interest aroused by Chemical Corps officers of the United States Army, the entire collection of some 5,000 items was transmitted to the museum at Edgewood. The Germans, who had made great strides of their own in fashioning chemical equipment, had also been first-rate collectors of other nation's efforts. Russian, Italian, and French items, as well as objects of smaller European countries were represented, with each item identified, catalogued, and described in detail. This rich chemical warfare coverage of Europe dated from about 1915 until 1944 and is perhaps the most important contribution made to the maintenance of this history.

After World War II, the museum was further expanded by the inclusion of an extensive group of Japanese objects. Ranging in size and purpose from gas masks to decontaminating trucks, the collection affords an excellent survey of this nation's contributions to a type of warfare not used during the Pacific campaigns.

—U.S. Army Photo

ARMY CHEMCAL CENTER, MARYLAND—CHEMICAL CORPS MUSEUM:— These munitions are part of the exhibit of Japanese arms and chemical devices at the Chemical Corps Museum, Army Chemical Center, Maryland.

Technically speaking, the classification of chemical warfare equipment falls into two categories, defensive and offensive. Under the former are included gas masks, smoke generators, air purifiers, protective clothing, and noise makers. Gas masks are the most familiar objects when speaking of chemical warfare and the museum has hundreds on display.

It is ironic to note that the oldest face mask, developed in Germany about 1900, was made for civilian firemen to help them in escaping the choking smoke of a fire. On display at the Chemical Corps Museum, this is an awesome-looking thing, festooned with many pipes and dials, It has many quaint features, including built-in glass wipers with which the wearer could wipe away moisture that collected on the inside of the eye pieces.

During World War I, when the Germans first employed poison gas on the battlefield, the British and French troops were woefully unprepared to meet this type of attack. Resorting to a primitive means of defense, they covered their mouths and noses with pieces of gauze similar to surgical masks and left the rest to chance.

When the critical need for these devices became known, millions were produced by the people back home in about one week's time and there are examples of these in the museum. About this time in the United States, which was still neutral, an Episcopal clergyman living at Emmorton, Maryland, became concerned with the plight of the Allied troops and set out to develop a gas mask, which he shortly did. Not at all like the masks which we have today, since it did not have a face piece, it consisted of an air purifying apparatus with a tube attached. The wearer merely stuck the tube in his mouth and breathed pure air. The invention was turned down by the United States military authorities but when later models were accepted and made general issue, the

Rev. Crawford-Frost claimed that he was the first to devise such a contraption. The original invention and all the accompanying diagrams were subsequently given to the museum and now make an extremely interesting display among its more unusual features.

From these early beginnings, the development and improvement of the gas mask may be readily traced down to the present time, since the military, civilian, and industrial masks of 30 nations are represented both in the experimental and accepted stages.

Of interest also are the masks developed for animals, particularly those devised for horses and dogs. There are examples of each ingeniously contrived and furnishing these animals with the utmost protection. Along same line, the Germans made a camel gas mask, probably with the intent of employing it, if necessary, in the campaigns of the Afrika Korps. The Japanese went them one better and originated masks for both cows and camels. The construction of the latter can only be explained in that it quite possibly was a facet of the grandiose schemes of the Japanese militarists to conquer India.

—U.S. Army Photo

ARMY CHEMICAL CENTER, MARYLAND—CHEMICAL CORPS MUSEUM:—Protective clothing and equipment for animals, part of the American Defensive Exhibit at the Chemical Corps Museum, Army Chemical Center, Maryland.

Among some unusual masks is one developed for children. In order to quiet a child's fear of donning a mask, this particular one was fashioned to be a replica of the cartoon character Mickey Mouse, complete with red button nose and large ears.

Thus today's gas mask, even in its most unusual forms, is a far cry from the early gauze face pieces. In this defensive device, as in many others displayed at the museum, the progress has been enormous.

Another display of interest at the museum is the collection of warning devices. Since it is important to alert individuals that a gas attack is imminent, various nations have developed different types of warning devices. Assorted gongs, sirens, Klaxons and noise makers which in appearance resemble enlarged versions of Hallowe'en toys are displayed on the museum's show tables and, judging by the clamor they make when tested, would be tremendously effective.

One of the best-known of the Chemical Corps items of defensive equipment is the smoke generator. The public, which has become acquainted with them in operation numerous times in newsreels, is familiar with the manner in which both friendly and enemy troops on land and sea advance and withdrew under the protection of a chemically generated smoke screen. The only object which the museum has obtained from the Korean conflict is a Russian-made smoke pot found near Seoul in 1950. The smoke thus produced is not poisonous, and it has proved its worth in many types of military operations.

Turning now to equipment used on the offensive, incendiary and napalm bombs, mortars and flame throwers come under this heading. It is interesting to note that the mortar, a weapon which has come into startling importance in Korea, was originally developed by and for the Chemical Corps to project high explosive and phosphorous shells.

—U.S. Army Photo

ARMY CHEMICAL CENTER, MARYLAND—CHEMICAL CORPS MUSEUM:—Part of the Russian Exhibit at the Chemical Corps Museum, Army Chemical Center, Maryland.

Now classified as ordnance property, the mortar is a descendent of a weapon invented by a Capt. Livens of the British Army during World War I and known as the Livens Projector. A cumbersome weapon with a large tube, it was sunk into the ground and contained a charge which when exploded hurled a shell tumbling end over end for a short distance. Out of this emerged the mortar, many designs of which are on display in the museum. Large German and Japanese examples may also be seen, attesting to the fact that many nations have appropriated a single idea and developed it according to their own strategy and planning.

Among the most efficient weapons in the arsenal of chemical warfare are flame throwers and napalm bombs. The former, one model of which can be carried on a man's back, shoots a searing burst of flame at a target with the accuracy of rifle fire. This is the weapon that American soldiers and marines used so effectively against the Japanese in World War II.

In Korea the deep intrenchments employed by the enemy have created a tough job for our troops. The Air Force, striking again and again with napalm, has killed thousands of the enemy in their emplacements, easing greatly the stress placed upon the advancing UN infantry by a deeply dug-in foe.

The director of the Chemical Corps Museum, Laurence M. Phelps, carefully points out that the museum's consistent expansion creates numerous problems as to arrangement and display space, making it unlikely that the work will ever be ended. Research never ends.

The museum affords an opportunity to study the work of foreign nations as well as our own scientific progress, and the Chemical Corps will continue to make frequent use of its collections as we prepare to meet and counteract any threat made by any enemy.

SPP's—SOLDIER-TECHNOLOGISTS

FOREWORD

The following article is an objective summary of the Army's Enlisted Scientific and Professional Personnel program as it applies to the Chemical Corps. It has been written in a simple and straightforward manner. To the cursory reader it may seem that the young men quoted in the article have raised an unduly large number of faults with the program. True, as with any new piece of machinery or new project, there are always a certain number of "bugs" which must be worked out. The SPP program is no exception, and we of the Army and the Chemical Corps realize this. This program creates a new manpower segment within the Army . . . a segment of men that are neither scientists nor soldiers. Just out of college, these selectees must be considered as apprentice scientists; and, with only a minimum of basic training, they can hardly be considered as having earned their spurs as soldiers. Theirs is a somewhat indeterminate position. Now as it is, great benefits are already being derived from the SPP program. We are utilizing these men in the type of work for which their talents best suit them; we are fostering in some a desire to continue their military science work through a Civil Service position; and we are giving these youths a headstart toward working up the ladder of success in industry. The value of the program to industry has been amply shown in the large number of recruitments made by industrial firms as these men end their two years of military training. I am glad that the editor of the Armed Forces Chemical Association Journal has seen fit to publish this article and give the military and industrial members of the association a clear picture of the program.

E. F. BULLENE
Major General, USA
Chief Chemical Officer
Department of Army

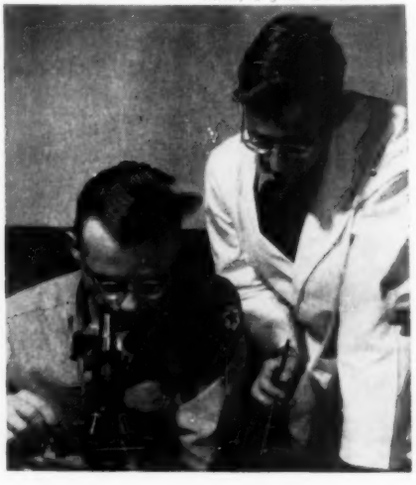
By PFC BYRON LEYDECKER

The age-old gripe that a truck driver always winds up as a cook in the Army, and that the Armed Forces never take into consideration a man's education and training in making job assignments has been alleviated in part by an Army program which has gained added stature under impetus of the Korean war. Army enlisted men who have received college or university training, or who are specialists in other fields because of job experience, now are classified by the Army as "Scientific and Professional Personnel" (SPP) and are assigned to work in their fields. Thus, today, if Albert Einstein were drafted, he would stand a good chance of being put to work as a physicist.

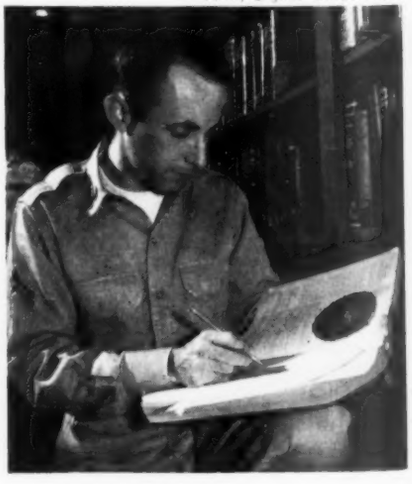
Army policy has changed since inception of the program in 1948, but in general terms, engineers, science majors and various other specialists are funneled into the Army-wide program from basic training stations. After completing 16 weeks of basic training, SPP's move into various branches of the Army—usually the technical services—to be put to work in those job fields for which they have been trained. This doesn't mean that all college graduates, or all those who are

The man pictured below is a chemical engineer formerly employed by the Phillips Petroleum Co. Pfc. John J. Moon, a graduate of the Illinois Institute of Technology, now works in the Dugway Proving Ground's Agents Branch, where his initiative, foresight, and practicle experience are very valuable.
—Army Signal Corps Photo

Pfc. Jack C. Mallory, at right, assists a student in the laboratory of the Chemical Corps School at Fort McClellan, Ala. Private Mallory, one of the Chemical Corps' group of Scientific and Professional Personnel, is a laboratory technician and instructor. He was chosen for this position because of his background in biology and physics. He received his B.S. degree from the University of Richmond (Va.)
—Army Signal Corps Photo



Cpl. Elmer N. Hamilton searches for technical material in his work as technical textbook writer in the Chemical Corps School Publications Agency at Fort McClellan, Ala. Corporal Hamilton, one of the Chemical Corps' group of Scientific and Professional Personnel, was chosen for his position because of his background in chemistry and mathematics. He received his B.S. degree in education at Shippensburg State Teachers College, Shippensburg, Pa.
—Army Signal Corps Photo



THUMBNAIL BIOGRAPHY

PFC BYRON W. LEYDECKER

Pfc Leydecker was stationed at Camp Detrick, Frederick, Maryland, as an SSP at the time he wrote this story. He since has been released from active duty with the Army and now is living in Atherton, California. He has served on active duty for almost three years, 11-and-one-half months of which he spent in the Navy aboard the U. S. S. Iowa at the end of World War II. After his release from the Navy in August 1946, he returned to college and was graduated from Stanford University at Palo Alto, California, in June, 1950. He was inducted into the Army in September, 1950, and after completing basic training at Fort Ord, California, was assigned to Detrick as a statistical research specialist. He served at Detrick until his release from active duty in September, 1952.

specialists in some job-field, go to work in pursuits similar to those which they held in civilian life, for the Army's main job still centers around the Infantryman, the soldier. The program does insure the most effective employment of trained personnel for whom the Army has a need. The Army Chemical Corps, for example, has found the program almost indispensible in its post-Korea expansion of research programs.

In this day of the drive toward what some call "push-button warfare," the need to use personnel wisely—both in the Army and out—becomes paramount. Strangely, virtually all other resources of the country have been used more effectively than manpower in past decades. Now two years after a vast expansion of our Armed Forces, the Army SPP program has proved to be successful in getting the most from what rapidly is becoming one of our most precious resources. With the ideological conflict splitting the peoples of the world into two great camps, the Communists—with their programs of imperialism—have thus far strong-armed to their side a preponderance of the world's population. This fact is forcing the Western world to try to increase the worth of each of its citizens. In this effort the Army has made great strides.

Since early last fall a large number of SPP's have been

Pfc. Robert W. Potter, formerly employed by the General Electric Co., and a Cornell graduate, performs duties for the Decontaminating Branch at Dugway Proving Grounds, Utah, which utilizes his mechanical ability.
—Army Signal Corps Photo

The man working with formulae in the picture is Pfc. Louis F. Theiling, Jr., an acting corporal working on the syntheses of organic chemicals. A superior scientist, he has a PhD. from the University of North Carolina, and in his spare time instructs at Dugway for the extension course offered by the University of Utah, where he holds an associate professorship. He is considering working for the Chemical Corps in a civilian capacity.
—Army Signal Corps Photo

Cpls. James F. Scheible and William M. Matsos developing prints in the Chemical Corps School photographic laboratory, Fort McClellan, Ala. Two of the Chemical Corps' group of Scientific and Professional Personnel, both were chosen for their positions as photographers because of their background in the field. Corporal Scheible received his B.S. degree in chemical engineering from the University of Rochester and was employed by Eastman Kodak Co. before entering service. Corporal Matsos was graduated from Marshall College, Huntington, W.Va.
—Army Signal Corps Photo

winding up their work under the program as induction terms expire. In an attempt to retain many of these SPP's, the Chemical Corps—at individual installations—has worked out elaborate job-schedules so that firm offers can be tendered these men when discharge time rolls around. Those who accept positions will doff khaki and stay in their same jobs—as civilians. Most of these positions are relatively high up in civil service brackets with exact grades dependent upon individual qualifications. John E. Thompson, civilian personnel officer at the Chemical Corps' Camp Detrick, Maryland, has said that pay for such personnel will range up to approximately $6,000 a year. Many of the SPP's now serving with the Chemical Corps have indicated a desire to continue in their present jobs after release from active duty. The program is proving itself. The greatest judge of all—the soldier—is agreeing with the Army on job assignments.

A typical SPP is Chemical Corps Private First Class Joseph A. Prestele, radiological safety inspector at Camp Detrick. He's been stationed at Detrick for about 18 months now, and has become the Post expert on radiological safety. Prestele, whose home is in Englewood, New Jersey, was graduated from the Stevens Institute of Technology with a bachelor of science degree in mechanical engineering. He worked for the Consolidated Edison Company of New York for about a year before Uncle Sam beckoned. He completed his basic training—which all GIs go through, SPP or not—at Fort Dix, New Jersey. From there Prestele was assigned to Camp Detrick and has worked with the Post's Safety Division ever since. The Chemical Corps has put to use Prestele's college training and job experience and has made him into the Post expert on radiological safety. Also, since assignment to Detrick, Prestele has been sent to radiological safety courses given at Oak Ridge, Tennessee.

Many of these enlisted scientists hold advanced degrees. At Dugway Proving Ground, Utah, another Chemical Corps post, two men with doctor of philosophy degrees are hard at work for the Army—as privates. One is Private First Class Louis F. Theiling Jr., an organic chemist with a Phd, from the University of North Carolina. The other is Private First Class Edwin C. Coolidge who holds a similar degree in chemistry from Johns Hopkins University. Theiling holds an associate professorship from the University of Utah and has found the time outside his Army duties to instruct several extension courses which that university offers SPP's at Dugway. Many of these men have completed work on master's degrees in this manner. According to the public information officer at Dugway, Theiling is giving serious consideration to the prospects of staying on with the Chemical Corps there after his release from active duty. Coolidge, a member of the American Chemical Society, was elected recently to the presidency of Dugway's Technical Society—an innovation in the Army which has spread to many other Chemical Corps posts.

At the Army Chemical Center, north of Baltimore, Maryland, Corporal John Ward and Private First Class Kenneth Vander wrote to Dr. Thomas H. Chilton, president of the American Institute of Chemical Engineers and technical director of the E. I. DuPont de Nemours Company in Wilmington, Delaware, to ask advice about forming a chemical engineers' club at the Chemical Center. Dr. Chilton greatly encouraged formation of such a club, and he felt that it should be organized so as to become a local chapter of the institute. Brigadier General William M. Creasy, commanding general of the Chemical Corps Research and Engineering Command and himself a member of the institute, got behind the soldiers and boosted them in their efforts to get the club underway. As the club now operates, guest speakers appear before the group each month—speakers talking on subjects of interest to the men and of value to the Chemical Corps in its effort to further train its personnel. A similar club for the soldier-scientists in the field of statistics and quality control also has been formed at Army Chemical Center, the Post at which the greatest number of SPP's in the Corps are located—some 800.

One of the best aspects of the program—at least to the person supporting the Armed Forces—is the savings the SPP program means to the taxpayer. Mr. Thompson has estimated that it costs the Chemical Corps about $200 apiece to recruit technically trained civilian personnel for research and development projects. This amount is cold savings to the taxpayer in the case of SPPs. Also the basic training each soldier goes through means that the SPP is ready to battle it out with the enemy on two fronts. However, this dual soldier-scientist status has its less desirable aspects. The dual role leads to one of the soldiers biggest gripes about the program—not much rank and much of the discrimination and duties that are associated with the lowest enlisted grades. Many of these technical men feel they shouldn't be required to pull kitchen police duty once they are assigned the more important technical duties; that they should be commisioned officers; or that they are detailed unnecessarily to many duties which seem unimportant compared to their technical jobs.

Virtually all the Chemical Corps SPPs feel they have benefited from the program. A report from First Lieutenant Robert Cintron, Dugway Proving Ground public information officer, indicated that although the routine military duties of SPPs at that base were relatively few, some of the SPPs feel they interfere with technical work—psychologically especially—and should be performed by non-technical or regular Army men. "While many SPPs underestimate the importance of these 'other' duties," Lt. Cintron reported, "they usually are very conscientious about their scientific work." This report is substantiated by similar reports from virtually all other Chemical Corps installations.

Another gripe caused by the dual status—or perhaps merely an extension of the same problem—was mentioned in Lt. Cintron's report. This is the fact that as enlisted men SPPs must spend much of their time at formations, kitchen police duties, parades and similar activities, all of which detract from time which otherwise could be spent on the more urgent technical work. Actually the situation as described seems to magnify the complaint. Facts show that these "other" duties are not on an either-or basis. These duties are in addition to technical duties—with a couple of exceptions—rather than in place of technical duties. The exceptions are kitchen police which requires one day's work each four or five weeks and troop information programs which consume about a half day each week. Lt. Cintron reported—and it appears to be true for other Chemical Corps posts as well—that SPPs spend about 40 hours a week at their technical duties. On the face of it, this situation seems to be fairly unimportant. However, it does appear odd that technical specialists pull kitchen police as privates while others are exempt whose duties seem less important in the over-all defense picture—truck drivers, car drivers, unit orderlies and personnel men—because they happen to be sergeants. Actually all these gripes are but a part of the single overwhelming complaint—practically no promotions.

The promotion dearth arises because of the fact that the Army still is organized—as always—for combat. In most cases SPPs are in an overstrength category in relation to the rest of the Army. Grade requirments within the Army appear to be based on the entire Army's combat strength at any given time. In other words the number of generals, colonels, majors and so on right on down to sergeants and privates is determined by the Army's combat strength. While SPPs do receive full basic training, that is all the Army combat training they usually do get. However, if all SPP's were made sergeants, or were commissioned for example, and a need for these soldiers existed in purely combat areas, then such personnel would go into battle at best as a green squad leader, platoon leader or company commander. In almost all instances men under them would be more highly trained in the art of war. It isn't

too hard to estimate the poor odds under which such a unit would labor.

Not realized by many SPPs who feel they are discriminated against in the matter of promotions, is the fact that all promotional grades must be balanced. Promotions must depend upon the number of spaces alloted to each unit commander for each grade. These spaces are authorized in both combat and service type units, by grade and number, in accordance with rather detailed standards which are based on factors such as actual current requirments, range of responsibility, and technical proficiency. Thus, a soldier, no matter how efficient he is, must also await an unfilled vacancy in the grade above his own before he can expect a promotion. Since there are also time-in-grade requirements, the 18 to 24 months a SPP serves with the Chemical Corps is such a short length of time that it definitely limits how high a man can climb on the promotional ladder.

There is another bright side to this unfortunate situation. In an overwhelming majority of cases these soldier-scientists have been appreciative of the opportunity to go on working in the field for which they were trained, to stay in the United States in most cases, and perhaps even to continue their education during off-duty hours. They feel a great sense of worth to the nation's defense effort, and generally feel they have been used to the best possible advantage under the circumstances. As First Lieutenant Marvin F. Grostic, Public Information Officer at the Chemical Corps Training Command, Fort McClellan, Alabama, reported, "SPPs here are satisfied with their job-assignments regardless of their personal beliefs concerning the Army or the Chemical Corps as a career."

Some typical thoughts by SPPs on this subject were pointed out by Private First Class Herbert J. Wagner who was recommended as outstanding among more than 35 SPPs by Captain Clyde L. Friar, executive officer of Camp Detrick's "M" Division.

Wagner said he felt that the first problem arising from the placement of the soldier-technologist was a more or less psychological one. He said: "It is generally conceded that for an engineer to perform professional work—that is work requiring original thought—he must be given a job from which he can gain satisfaction ." He went on to point out that satisfaction in a professional job could be obtained from one or more of several factors—remuneration, opportunity for advancement in position, recognition for services, or some equality between capabilities and job requirements. Wagner said that inasmuch as remuneration and advancement possibilities are nil, the SPP must receive recognition for services which are closely in line with cavabilities of the individual in order to gain satisfaction. He went on to define satisfaction as "that inner feeling of accomplishment which would put an SPP in the frame of mind necessary for constructive thought." Wagner said such a definition disallows use of the argument that the SPP "will do his job or be sent to Korea," for a man under pressure to perform mental tasks rarely produces efficiency.

Wagner further said that within this framework the soldier-technologist could be handled two alternate ways when making job-assignments. The first would be to assign him professional tasks and recognize that his only return would be personal satisfaction. The other method of placement would be to consider the SPP as a technician, not capable of independent thought. "An engineer in a civilian life might demonstrate his ability under this second set of circumstances," Wagner said, "by hard work and ultimate proof in becoming a true professional. The soldier on the other hand is apt to perform just his simple technician's function. Since the soldier-technologist's job satisfaction is derived from recognition and good job-assignments, treatment as a technician can only further restrict his ability to think professionally. The SPP in such a situation is left with the negative incentive of 'do your job or you'll be sent to Korea,' and as a result accomplishes a bare minimum of constructive thought. The consequent loss of potential manpower is obvious," Wagner concluded. Many of the jobs held by SPPs, however, compare exactly or closely with those they pursued in civilian life.

In the Chemical Corps engineers of practically all types number highest among the various represented vocations. In addition, the Corps has among its members technical writers, architects, draftsmen, statistical research specialists, biologists, chemists, agronomists, physicists, meteoroligists and others.

A quick glance at the list of specialties clearly shows how valuable many of these men must have been in the Chemical Corps' expanding defense program. Not only would the cost of recruiting comparable civilian personnel been high, but such personnel would have been difficult to secure under any circumstances. Technically trained manpower has been most scarce throughout this period of post-Korea expansion. Moreover, the Chemical Corps found in the SPPs an already trained manpower pool from which it could drain badly-needed personnel. For the SPP the program meant an opportunity to go on in the field of his choice and training. Each such person who stays with the Chemical Corps—either as military or civilian—after original induction tours lapse, means valuable savings to the Corps, the Army and the American taxpayer. The SPP already is oriented and trained to his particular job. Additional funds won't be needed to accomplish these always-present job requisites.

In practice, responsibilities of SPPs vary widely both within the Chemical Corps and undoubtedly in the other branches of the Army. Almost universally SPPs' responsibilities far outstrip their rank, but nevertheless generalizations are dangerous. The reasons for this are similiar to those which would apply without the Army establishment in most cases. However, there are two reasons of a general nature which account for wide differences in responsibility within the SPP program. In some instances these same reasons can be extended as a basis for not assigning more responsibility to the SPP where such defections have occurred. These are what might be termed considerations of individual and time horizons.

Individual differences among these men usually have been the determining factor in the placing of responsibility. This is little different from industry of course. The point which appears important in this program, however, is that the lower end of the scale—or the "drone" group—apparently is much larger in this program than is found elsewhere. Perhaps the reason for this is that there are practically no promotions, there is little incentive, or because of the many other minor irritants of the program which already have been discussed. There is one other group which will not produce as well as it could, however, because of displeasure with the entire military experience. This group occupies an extreme position obviously, and fortunately is but a slim minority among the discontents. The arguments of these men merely point up with some intensity the general problems of the program. Such an individual points out that he has spent four or more years of his life and anywhere from $5,000 to $10,000 acquiring an education which should be of high value to his country during this period of limited mobilization. For this effort, he now receives little return. He says that he has tried to better himself technically and has tried to strive for the higher goals, and he was wound up on one of the lowest rungs of the ladder. His civilian counterpart not only is receiving about four or five times as much pay, but is occupying a position of high esteem in the community. It is human nature, this group contends, to want the rewards for successful effort. These rewards the SPP, in large measure, is asked to forego.

The Army's answer to all this—both extremism and legitimate complaints—is that it's hot, or cold depending upon the season, in Korea. While such a statement seems incredible when viewed from an over-all national defense need, the point has some merit. Consider the non-SPP who was either

unable or did not want to go to college, and who is being asked to place his life on the auction block of some distant battlefield. What appears to be important from all of these gripes is that some readjustment of the SPPs' position is necessary if they are to produce in accordance with abilities. The Army seems to recognize this fact.

The time horizon problem appears to be more difficult to overcome. The Army's technical services obviously have no control over Selective Service Boards which are the suppliers of technical as well as non-technical personnel. This means that a service such as the Chemical Corps must integrate such scientific and professional personnel in an extremely arbitrary manner, or alternatively lose the skills through default. The service has a need for such personnel at one time, —and there is no personnel. Or conversely, it has no need,— and it is swamped with such men.

Since the initial draft influx of SPPs, most enter the service shortly after June graduations. This means that the technical service can allow for induction, 16 weeks of basic training and then count on receiving such personnel sometime in the fall. However, that is about all such a service can predict with accuracy. This single fact can't be used as a basis for future planning obviously for the service still has no way of knowing whether any such men will be available. If a need for SPPs exists when such manpower can be had there is no problem. Frequently this is not the case. An SPP arrives at a station ready to assume professional duties, and there is no such job open. Or, there are many such jobs vacant and no one to fill them. One seldom hears about the latter situation for the job usually gets done somehow. The SPP who arrives at a station expecting a professional assignment and instead is given a technician's assignment is quite vociferous.

The program provides for the reassignment of such men if they cannot be utilized at any particular station in the field for which they have been trained. Logically, however, an SPP won't be declared surplus if he can be placed as a technician, or in some position requiring more than average intelligence and fairly well allied with his field of training. The point here is that the SPP is being used in his field, but to a lesser degree than his capabilities warrant. This is not the end of the problem, though.

An SPP is drafted for a limited period—two years. That he may not be assigned to many jobs which he otherwise would be capable of filling, is traceable directly to this fact. Eighteen months is a relatively short period, especially in research projects, and this bars many SPPs from professional positions. Actually, 18 months is the longest tour which the technical services can expect from their men since basic training consumes four months, induction and reassignment takes at least two more months. What has happened in practice is that the SPP is assigned to a more permanent civilian technologist as an assistant. This leads to recognition for the civilian rather than the soldier-technologist in most cases, and a consequent lack of interest on the soldier's part.

Many of these men do have relatively heavy responsibilities, however. As a measure of their responsibilities, a survey conducted recently at Detrick showed that of out of a group of 200 such men, seven were clasified with a civil service rating of GS-11, 32 were rated GS-9 and 77 received a rating of GS-7. The odd numbered civil service ratings refer to technical positions. Considering that any rating above GS-15 must receive congressional approval, and that the highest rating is GS-18, this means the SPP definitely has received paper recognition of his value. Salary-wise, GS-11 starts at $5,940 a year, GS-9 begins at $5,060 and a GS-7 starts at $4,205. Not all of these men have been offered positions on the salary basis described above, but when they were approached through the survey 93 of the men said they would consider employment if tendered similiar grade ratings to those used in the survey. Only 107 men said they would not consider future civilian employment on terms offered in the survey.

The reason there might be a discrepancy between ratings suggested in the survey, and actual ratings which the SPP would be offered if he decided to stay on is that the survey ratings were assigned by section chiefs. The SPP still would have to qualify specifically under job requirements of civil service. In other words, an SPP holding a GS-11 position now might not have the necessary years of experience to qualify as a GS-11 under civil service ratings.

Another approach to the measure of SPPs' responsibilities is contact with outside governmental and private agencies or businesses. Private First Class Walter H. Dickinson, 25-year-old mechnical engineer from Swarthmore, Pennsylvania, now working in Camp Detrick's "M" Division, has estimated that he spends at least 10 per cent of his working hours as a liaison representative to other governmental agencies such as the Naval Ordnance Laboratories in Washington, D. C. In such a capacity he is a representative of Camp Detrick and has some responsibility of coordinating activities in the Post's developmental programs. Other aspects of Dickinson's work includes responsibility for designing and testing much highly technical equipment.

Regarding contact responsibility of SPPs with outside agencies, a personnel representative from Revere Copper and Brass Company of New York recently said it was not at all unusual for a private or private first class to come into that company's plants to check on various engineering problems encountered under government contracts. The personnel man was at Detrick to interview SPPs scheduled for release from active duty shortly, for possible placement with that company. He said Revere had learned of the program through such visits by enlisted men. He explained that during World War II such "inspectors" usually held the rank of a captain or major, but that now the company deals mainly with privates under such circumstances.

Revere is typical of many large and small private industrial companies which have been visiting Chemical Corps posts recently in an attempt to procure technical personnel slated for early release from active duty. At Army Chemical Center an elaborate job-placement set-up has been organized for just such a purpose. This is additional proof of the value the Chemical Corps places on its SPPs. It is making an effort to help these men make the transition back to civilian life as painless as possible—if they don't want to accept employment with the Chemical Corps. At the Army Chemical Center, General Creasy has invited personnel representatives from industry to that Post to hold job-interviews with the SPPs. Thus, many of these men can have civilian jobs lined up before their release from service, industry has an easier go at badly needed technically-trained personnel and the Chemical Corps breeds goodwill on both sides of the fence. Of course, the Corps hopes many of these specialists for whom it has a need will stay right on in a civilian status. That many of the Corps' SPPs plan to do this is an accurate measure of the program's worth.

There are, of course, inequities in the program—most of which have been mentioned in this report, perhaps even to the exclusion of the preponderance of desireable aspects. A fact which is much more important than the existing inequities, however, is that not only does the GI realize them, but so does the Army. Again, both sides realize the program's great merit, and both are working to overcome many of its shortcomings. Both sides feel they are on the right track. The Army is large—and like all other large organizations—changes slowly. That it does change can be seen in the program itself. World War II was full of stories about the scientist on the front lines and the rifle marksman in the laboratory. Though this situation still might exist in some cases, chances are that if a draftee has a technical background and the Army needs his skill, he'll be classified as an SPP and be put to work in his field.

MAJOR GENERAL ORLANDO C. WARD
Chief, Military History
Department of Army

THE CHEMICAL CORPS HISTORICAL PROGRAM

By DR. LEO P. BROPHY

Mr. Herbert G. Wing, historian, searching files for material to be used in writing chapter on Mechanical Flame Throwers for "History of CWS in World War II."

"Between the hours of 0650 and 0800 on November 30, 1944, at a point on the east bank of the Rhine River just north of the Swiss border, the first rounds of 4.2-inch mortar ammunition from the guns of the Second Chemical Mortar Battalion landed on German soil . . . . ."

That is an interesting little sidelight on Chemical Corps activities in World War II. It may not be worth much to you, or your neighbor, but to somebody it may answer a question, or recall memories of that morning near St. Louis, France. It is merely one of the thousands of factual items tucked away in the five score filing cabinets located in the Army Chemical Center Building No. 65.

Little-known, but of inestimable value for future generations, is the Chemical Corps Historical Office. Today, by putting together such bits of information as above, the Historical Office is completing one of the most tedious, but not unsatisfying, jobs in the Corps—the compilation of three volumes of history concerning the Corps and its activities in World War II. Tomorrow begins the job of culling out facts about the Korean situation from thousands of reports, letters, interviews, news releases and other sources of information. The day after? Well, that's for the future.

The Historical Office serves not only as a Chemical Corps repository for facts of history while it is in the making; it is also an integral part of the Army's whole military history program. This is not a new program, but it has only been in the past decade that its full value has been realized and steps taken to achieve the outstanding benefits that may be derived from recording history as it happened, instead of scores of years later.

The Office of the Chief of Military History, Department of the Army, in fostering the compilation of some ninety-nine volumes on the activities of the United States Army in World War II, is undertaking one of the most ambitious history writing projects of all time. A number of these volumes have already come off the press and have been favorably received both by students of military history and the general public.

Headed by Major General Orlando C. Ward, the Army's Office of Military History, has under its immediate jurisdiction eight officers and 126 civilians while 80 more civilians are spread throughout the various technical services. This number includes nine civilians in the Office of the Chief Chemical Officer. The Chemical Corps (known as the Chemical Warfare Service before 1946) has been allotted three volumes in the over-all ninety-nine volume series. These volumes will be discussed in more detail below.

The concept of writing an official history of the Army did not originate in World War II. During World War I a Historical Branch was activated in the War Plans Division, General Staff, and a similar branch was set up in France under the Commanding General, AEF. These branches collected and preserved records of outstanding historical importance. For a time the idea was entertained of writing an official history of the Army in World War I on the basis of the documents collected and the recollections of those who had participated in the conflict.

This fact is vividly portrayed in a letter written just nineteen days after the signing of the Armistice, by Major General William L. Sibert, Chief of the then-infant Chemical Warfare Service (activated 1 July 1918) to his various division chiefs. General Sibert stated that a Historical Branch had been activated in the administrative Division of his office to co-ordinate the compilation and writing of the history of the Chemical Warfare Service in World War I and he directed that each division chief appoint an historical officer to cooperate with the Historical Branch in carrying out its mission. The history of the Chemical Warfare Service, the general remarked, would run to about 100,000 words. It should be "as non-technical as consistent with a truthful and accurate account and wherever possible it should be of such a nature that it may be understood by the casual reader."

The history of the CWS in World War I as envisioned by General Sibert was never written, largely because of a change in the attitude of the War Department relative to the writing of official histories. In August 1919, the Secretary of War, Newton D. Baker, in a letter to the Chief of Staff, said that he felt that the War Department's participation in any historical project should be confined to collecting records and making them available to outside scholars. As a result of Secretary Baker's decision, plans for writing the official history of World War I were abandoned and emphasis was placed, instead, on collecting, sifting, and cataloging records. The Historical Section of the Army War College carried on these functions for a number of years and in 1948 seventeen volumes of these World War I records were published under the auspices of the Historical Division, Department of the Army (later designated the Office of Military History).

Although the program of publishing official World War I histories was interrupted, there was one exception made to the general rule. That was with regard to the Medical Department, which continued to work on and eventually, in 1926, to publish an account of its activities in the first World War. Because of the medical aspects of gas warfare, a discussion of the Chemical Warfare Service was included in the Medical Department history. Meanwhile, several other publications featuring a description of the activities of the Chemical Warfare Service had come off the press. These included Benedict Crowell's *America's Munitions* (1919) and Amos A. Fries and Clarence J. West's *Chemical Warfare* (1921).

President Franklin D. Roosevelt was primarily responsible for the Army's undertaking its World War II historical program. In a letter of 4 March 1942 to Mr. Harold D. Smith, Director of the Bureau of the Budget, the President said that he was interested in the steps being taken by Mr. Smith to keep a current record of war administration. Mr. Roosevelt urged that the program be pushed even more intensively and suggested that a committee on records of war administration, consisting of representatives of appropriate learned societies and of the Government, be appointed. The President concluded his letter by stating:

> "The present program strengthened in this manner might be helpful to the work of the Bureau of the Budget in planning current improvements in administration in addition to its main objective of preserving for those who came after us an accurate and objective account of our present experience. I hope the officials of the war agencies will bear in mind the importance of systematic records, and to the extent commensurate with their heavy duties, cooperate in this undertaking."

TOP: Mrs. Hilda M. Blackburn and Mrs. Alice E. Moss proofread manuscripts typed by Mrs. Fannie F. Brewer. Manuscripts are chapters of "History of Chemical Warfare Service in World War II." CENTER, front row: Mr. H. G. Wing, Historian; Pfc A. H. Raphaelson, Writer; Mrs. Hilda M. Blackburn, Editorial-Clerk Typist; Mrs. Alice E. Moss, Information and Editorial Specialist; Mrs. Fannie E. Brewer, Editorial-Clerk Typist; Mr. Brooks E. Kleber, Historian. Second Row: Dr. Leo P. Brophy, Historian; Col. George J. B. Fisher (USA, Ret.) Consultant; Dr. Paul W. Pritchard, Actg. Chief, Historical Office. BOTTOM: Mr. Brooks E. Kleber, historian, interviews Lt. Col. James H. Batte, Cml C, on Operations of 4.2-inch Chemical Mortar in European Theater of Operations in World War II.

The Director of the Bureau of the Budget, in conformity with President Roosevelt's suggestion, appointed a committee consisting of the following: Dr. Waldo Leland, Director of the American Council of Learned Societies; Professor William Anderson of the Social Science Research Council; Mr. Louis Brownlow, Public Administration Clearing House; Honorable Solon J. Buck, Archivist of the United States; Honorable Archibald MacLeish, Librarian of Congress; Professor Arthur M. Schlesinger, Department of History, Harvard University; Mr. Donald Young, Social Science Research Council; and Dr. E. Pendleton Herring, School of Public Administration, Harvard University, who was named executive secretary of the committee and chief of the research staff.

In setting up a historical program for the Army, Dr. Herring enlisted the active co-operation of Mr. John J. McCloy, Assistant Secretary of War, and Lieutenant Colonel (later Major General) Otto Nelson, Assistant to the Deputy Chief of Staff of the Army and a former student of Dr. Herring's. The activation of a vigorous historical program in the Army during World War II was due in no small degree to the enthusiastic support of Mr. McCloy and General Nelson. General Oliver L. Spaulding, Chief of the Historical Section of the Army War College, was responsible for many of the suggestions for getting the historical program into actual operation. A memorandum from the Secretary of War of 15 July 1942, embodying a suggestion of General Spaulding's, directed the commanding generals of the Army Air Forces, the Army Ground Forces, and the Service of Supply (later Army Service Forces) to appoint historical officers in their respective commands.

The Chemical Warfare Service, as an element of the ASF during World War II, initiated a historical program in the summer of 1942 with Major Jacob K. Javits* of the Control Division of the Chief's office acting as temporary historical officer. Major Javits was succeeded by Colonel John V. Lowe, who was appointed chief of the newly activated Historical Branch. Colonel Lowe in turn was succeeded in November 1943 by Major Clarke Robinson who remained chief of the branch until after the close of World War II.

During the war the Historical Branch wrote a number of monographs on CWS administration, research and development, procurement and supply, training, and field operations. The branch extended the historical program to the Chemical Warfare Service installations, a number of which compiled good accounts of their activities. These historical studies served as a starting point for the three published volumes on Chemical Warfare Service activities. In addition to the monographs, the Historical Branch complied a series of special studies which were published after the close of the war. This series consists of the following:

No. 1—Dr. Paul W. Pritchard, Smoke Generator in the Mediterranean and European Theaters of Operation.

No. 2—Herman Ochsner (formerly Generalleutenant), The History of German Chemical Warfare in World War II. Part 1—Military Aspect.

No. 4—Leonard L. McKinney, Portable Flame Thrower Operations in World War II.

No. 5—Leonard L. McKinney, Mechanized Flame Thrower Operations in World War II.

All of the above studies are of a *Restricted* classification.

The three volumes on the activities of the CWS during World War II will, of course, be unrestricted in classification, and will be printed by the Government Printing Office under the copyright of the Chief of Military History. The Historical Office (following World War II the title was changed from branch to office) has written almost all of the chapters for the volumes and has submitted them to the Office of the Chief of Military History for review. After a preliminary review the Chief of Military History submits the volumes to a special review board before publication. The make up of the three volumes, whose over-all title is, "History of the Chemical Warfare Service in World War II," is as follows:

Volume I—*Organization and Training*
- Part I—Organization, Administration, and Personnel Management, by Dr. Leo P. Brophy.
- Part II—Training for Chemical Warfare, by George J. B. Fisher, Colonel, USA, (Retired).

Volume II—*Materiel*
- Part I—Research and Development, by Truman Driggs, Jr.
- Part II—Procurement and Supply of Chemical Warfare Materiel, by Dr. Leo P. Brophy.

Volume III—*The CWS Overseas*, by Dr. Paul W. Pritchard and Mr. Brooks E. Kleber.

The writings of history soon after the event has advantages as well as disadvantages. The chief advantage lies in the fact that the historian is able to interview many of those who participated in the event and to weigh their respective testimonies against the various written records and documents. This is a tremendous asset over writing on the basis of documents alone, since documents do not tell the whole story. Moreover, in spite of the best efforts of archivists, librarians, and research workers it is often impossible to locate some important documents. In fact, it seems at times to the historian that documents, like money and old soldiers, just fade away. The gaps in the historian's information resulting from the absence of a document or two can well be filled by data obtained in an interview. And it is to the historian's advantage to obtain that interview before too long an interval after the event, because time plays tricks with the memories of most men.

General Sir Ian Hamilton, famous British commander of World War I, put this rather forcibly when he said, "On the actual day of battle naked truths may be picked up for the asking; by the following morning they have begun to get into their uniforms."

The chief *disadvantage* of writing history shortly after the event is the potential difficulty of placing the event in its proper perspective. So far as military history is concerned, the advantages of an early historical account far outweigh the disadvantages.

The principal documentary sources for the Chemical Warfare Service volumes were records of the War Department, the Army Service Forces, the Army Ground Forces, the Army Air Forces, and the Chemical Warfare Service. The research involved in combing these records was tremendous. It was incumbent upon the historians also to delve into all the history of higher echelons and other agencies of the Federal Government for background material. For example, to intelligently understand CWS tactics in a given operation it was necessary to know the over-all plan and strategy of the commanding general or officer. An instance of where research was conducted in an agency outside the War Department was with regard to the various treaties outlawing gas warfare, which involved the State Department as well as the War Department.

In the process of conducting research on the records referred to above the Historical Office made extracts or obtained duplicate copies of documents. The extracts were typed on 5" x 8" notes and systematically filed in the Historical Office. The duplicate copies of documents occupy some 100 cabinets in the Historical Office, which is now physically located in Building No. 65 at the Army Chemical Center, Maryland. Needless to say, this material is a most valuable source of information and on the basis of it the Historical Office answers numerous requests from the various elements of the Chemical Corps. A number of post World War II records and reports are also on file in the Historical Office.

The Historical Office at the present time is in the process of completing the World War II project and of initiating a cur-

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*Jacob K. Javits is at present a member of the House of Representatives from the state of New York.

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HISTORICAL PROGRAM

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rent historical program, inaugurated under a directive of the Office of the Chief of Military History. In contrast to the coverage of World War II activities, which was extensive and detailed, the current program calls for the compilation of special historical studies on the activities of the Corps. These studies will be of more immediate interest to the operating personnel of the Corps than to the personnel of the Army generally or to the reading public.

The studies will furnish one element of the Corps with information on other elements which should prove of assistance to all in conducting current operations. For example, the Research and Engineering personnel and the Procurement personnel will be supplied with data on the battle experience of Chemical Corps materiel, data which in the past it has not always been easy for them to obtain. The Historical Office, in a word, will act as a clearing house of technical information for the entire Corps. The Historical Office can do this because it is in the unique position of being the recipient of data from all elements of the Corps in the form of reports and records from both the Zone of Interior and the theaters. On the basis of these reports and records and whatever other evidence is available the historians will write the special studies. They will also make extracts of pertinent reports and records and will circularize these immediately to the personnel of the Corps.

WORK SIMPLIFICATION PROGRAM

Among the many drives and programs that the various Army agencies at the Army Chemical Center are constantly conducting to get the most out of every taxpayer's dollar spent and to insure maximum utilization of all personnel is the Work Simplification Program carried out by the Management Section of the Post Comptroller's Office.

With "organized application of common sense to find better and easier ways of doing work" as its goal, the program is currently in its third cycle at this installation. It will eventually be offered to first-line supervisors in all organizations and agencies on the post.

Under the general supervision of the Assistant Comptroller for Management, Mr. Edward J. Copes, the Discussion sessions and labs that make up the six-week course are led by two enlisted men with civilian backgrounds in Industrial Engineering and Business Administration, Pfc. Louis Washauer of St. Louis, Missouri, and Pvt. William Searle of Chicago, Illinois.

The course consists of four two-hour discussion sessions and three two-hour labs. At the discussion sessions Pfc. Washauer and Pvt Searle present the four basic tools of work simplification and in the lab sessions the student-supervisors bring in their "homework" for group analysis, criticism and discussion.

The four techniques presented in the course are graphic representations and charts that are designed to enable the supervisor to get a simple graphic conception of the work processes that go on in his section.

As described by Pfc. Washauer, the four items are the work distribution chart, "a picture of the activities of an organization, with the contributions of each employee;" the flow process chart, "a step-by-step account of how a job is done, following it all through the activity and providing a means of analyzing the entire preocess;" the layout chart, "an actual map of the office or shop, showing the flow of a specific piece of work through it," and the work count, "a technique for answering questions where the volume of work done is important, recording specific data for a specified period of time and projecting this data for an overall period."

Supervisors taking the course bring in these four items to the lab sessions after they have prepared them for their own separate activities.

Washauer listed three basic objectives of the work simplification program:

(1) To fully utilize the work capacities of all personnel working for the different activities.

(2) To streamline procedures so as to permit additional work loads without overtime and more personnel.

(3) To raise morale by introducing simpler and easier methods of getting a given amount of work accomplished.

BETTER READERS FOR THE CHEMICAL CORPS

By EDWARD J. OUELLETTE
Education Officer
The Chemical Corps School

Mr. Edward J. Ouellette, Education Officer of the Chemical Corps School at Fort McClellan, Alabama, author of this article. Mr. Ouellette has had considerable experience in this type of work both in Military and Civilian establishments. He came to the Chemical Corps School from the Armored School, Fort Knox, Kentucky, where he had a program of this same type for students of the Armored School.

The reading rate controller forces the student to read faster in order to keep ahead of the shuttle cover. Easy-type and interesting reading material is inserted into the machine and the machine is set at a certain speed which the student must follow. Exercise of this kind is used both for speed and comprehension.

The adoption of an industrial process which would cut production time at least 50 per cent and at the same time increase the quality of the product would be regarded as good sound business. The same kind of thinking has resulted in the establishment of reading improvement courses in our military service schools. For an investment of thirty hours training time, students are being trained to increase their reading rates from 30 to 100 per cent and also to understand more of what they read.

The need for improving the reading skills of the adult population has long been recognized. Studies of adult reading habits indicate that the average adult reads only 250 words per minute and understands only 50 per cent of what he reads. Reading tests given at our service schools indicate that the average officer also needs to improve his reading skills.

Anyone acquainted with the reading requirements in the more advanced courses in our service schools will readily agree that a student officer must face a voluminous reading task. An officer taking the Advanced Course at The Chemical Corps School must be a good reader in order to meet these heavy reading requirements. He must be able to read both rapidly and accurately. The average officer, like the average college student or adult, does not read with maximum efficiency. He reads easy material such as newspapers, service journals, and fiction at a rate of about 250 words per minute. Tests indicate that he understands about 60 to 70 per cent of what he reads. In order to develop more efficient reading habits many service schools are including reading improvement programs in their curricula. The Chemical Corps School initiated such a program for the 1951 Sixth Chemical Officer Advanced Course.

Tests given before training indicated that the Advanced Course students could be divided into four groups, each representing different types of readers. The first group which accounted for better than one third of the class was made up of those who read slowly (190-270 words per minute) and with a low degree of accuracy (40-60 per cent). The second largest group was composed of students who were also slow readers but who understood more of what they read (60-80 per cent). The remainder of the class was divided into two smaller groups. Both of these smaller groups read fairly rapidly with one very important difference, and that was accuracy of comprehension. Whereas some of the students were able to read from 375 to 400 words per minute with comprehension accuracy of 70 per cent or better, there were others who got very little from what they read. This low level of accuracy was probably due to test pressure or a faulty habit of scanning which caused some students to read "over their heads."

What are some of the skills that mark a good reader from a poor reader? Basically the good reader is a flexible reader; that is, he can adjust his rate of reading to his purpose. the

difficulty of the material, and the degree of comprehension he desires. The poor reader, on the other hand, reads "in one gear." He has one rate for all type of material. He may read difficult material in a slow and fairly efficient manner, but he is incapable of shifting into "high gear" when material is standard or easy. The good reader has developed other skills which make his job of reading a pleasant and satisfying experience. First, he has the ability to concentrate. He gives his full attention to the reading task, and nothing short of Gabriel's horn will divert him. The poor reader has to find a sound proof cell because any external sound disturbs him; and even under ideal conditions, he is often the victim of mind wandering. For the individual who has to struggle constantly to maintain attention, reading becomes an unpleasant task. Second, the good reader as he moves across a line of print sees groups of words, phrases, even whole sentences. The poor reader reads word by word. He sees each word in a sentence apart from the others; and consequently, he does not easily recognize meaningful thoughts. Third, the good reader also takes about half the time that the poor reader does to "take a look." Whereas the good reader takes about one-tenth of a second per fixation, the poor reader requires one-fifth of a second. Fourth, one of the greatest handicaps to rapid reading is the tendency to vocalize. The reader who repeats each word as he reads is limiting himself to a rate of about 250 words per minute, which is the normal oral reading rate. The "vocalizer" moves his lips, strains his larynx or listens to himself. Inward vocalizing, or listening to yourself read, is a habit that is difficult to eliminate. Vocalizing of this type can be eliminated if the reader succeeds in forcing himself to read rapidly, usually over 500 words per minute. Fifth, another basic skill quite necessary to good reading is the ability to move the eyes rhythmically and with a minimum of muscular effort across a line of print. The biggest obstacle to rhythmic movement is the tendency to regress or to reread words, sentences, even whole pages. Films tracing eye movements revealed that the average Advanced Course student was making almost four regressions for every 50 words of print. These eye movement pictures also showed irregular pauses as the eyes moved across a line of print, another reason for slow, fatiguing reading.

The job of improving these student's reading ability is essentially one of developing or improving basic reading skills. The reading improvement course attempts to improve the ability to see more and see it quickly and accurately, to visualize and not vocalize, and to move the eyes in a regular, rhythmic pattern. Above all, however, is the basic job of developing flexibility.

How are these basic skills developed or improved? The course requires 30 hours. Before his training begins, each student is given reading tests and a general eye check. He also has a picture taken of his eye movements. The results of these tests are used to guide the student during the training phase. Once the initial tests and orintation have been given, the program is essentially one of self training with assistance and guidance from the instructor as the individual progresses in his training.

The student spends each period using two devices. One is the tachistoscope or flash meter, which permits the student to observe a series of digits at various speeds. Most students start by observing five-digit numbers at 1/25 of a second. As proficiency increases, the shutter speed is increased until the student can see the numbers accurately at 1/100 of a second. This same general procedure is followed in progressing from five-digit numbers at 1/25 of a second through nine-digit numbers at 1/100 of a second. Training on this device is helpful in developing a wider eye span and in reducing the time required for fixation. The other device used by the student is a reading rate controller or accelerator. This device consists of a platform on which the reading material is placed. A shutter comes down over the page at a predetermined rate. The object is to force the student to read more rapidly. The student is encouraged to keep getting rushed by the shutter. For each subsequent period, the setting is increased to develope a faster reading rate. Speeds as high as 1500 words per minute were attained by some students using this device. The student spends the remainder of his training time in taking training tests that give him an indication of his progress and also to teach him how to adjust his rate to gain a reasonably high level of comprehension.

What benefits were derived from this training? As a result of 30 periods of training, the average (median) rate for the class increased from 259 words per minute before training to 415 words per minute after training, a gain of 60 per cent. Comprehension increased from an average (median) of 70 to 75 per cent. An examination of individual student records is more revealing of the benefits to be derived from this type of training. One of the better readers in the class before

Mr. Edward J. Ouellette, Education Officer of the Chemical Corps School, Fort McClellan, Alabama, uses the opthalmograph to measure the eye movements of a student. This machine photographs the eye movements and gives a permanent picture for study of eye span, fixation time, regressions, and general eye movements.

Student using the Tachistoscope. Here the student views slides of various sized digits at varying speeds (25th to 100th of a second) in order to widen the eye span and reduce fixation time. This exercise helps one to take in more at a glance and to see faster.

training tested at 307 words per minute with 77 per cent comprehension. After training his rate had increased to 643 words per minute with 74 per cent comprehension. In view of an increase in rate of 109 per cent, the slight decrease in comprehension is not particularly significant because the level of comprehension is still quite adequate for practical purposes. The slowest reader before training averaged 190 words per minute with a score of 54 per cent for comprehension. On his final tests he averaged 394 words per minute with 77 per cent comprehension. This student obviously benefited greatly from the training.

In spite of the fact that significant gains are made in rate and comprehension during the course, many people ask if the effects of training will remain. The answer depends primarily on the individual's continued use of the skills he has developed. Follow-up tests given to students at the Air University and The Armored School from four to six months after training indicate that some loss in rate will occur. Generally the loss will not average more than 20 per cent of the original gain. The follow-up tests given to the Sixth Chemical Advanced Class four months after training show an average drop in rate of only 20 words per minute, from a post-training rate of 415 words per minute to a follow-up rate of 395 words per minute. This represents a loss of only 13 per cent of the origional gain. Significant also is the tendency for comprehension to improve. When class performance in comprehension is compared to the standards established for college freshmen, the gains represented marked improvement. Before training, the average comprehension for the Advanced Course students was better than 53 per cent of the college students previously tested with the same tests. After 30 periods of training, the class scored higher in comprehension than 59 per cent of the college freshmen. Four months after training, the class when compared against the same norms, was reading better than 81 per cent of the college freshmen. This represented an overall gain of 28 percentile rank norms in comprehension, the greatest increase coming some time after the end of training. This post-training increase in comprehension was due principally to the students' recognizing the point where they could read with maximum speed and at the same time achieve a high level of comprehension. Examination of individual gains and losses in rate and comprehension presents a rather encouraging picture from the standpoint of the lasting effects of training. Of nineteen students tested, eight showed increases in rate since the end of training. Of these eight, five showed further increases in comprehension, one showed no change and two a loss. Eleven student experienced some loss in rate, but again nine of them showed increases in comprehension and the remaining two experienced no loss.

Students have reacted enthusiastically to the reading improvement program. We must remember that in this type of type of training the student is pretty much on his own, and no grades are given that directly influence his class standing. All students, nevertheless, realize the indirect advantages of such training as it affects their course of study. Student reaction to the training as measured by a questionnaire revealed that all students felt that they were able as a result of the course to read such materials as newspapers, magazines, novels, and standard non-fiction much more rapidly than before. Seventy-five per cent felt that they read such material at rates varying from 30 to 100 per cent faster than before training. Twenty-five per cent of the students indicated that they were reading over 100 per cent faster than before training. No sutdent felt that his ability to comprehend has been lessened. All but one student indicated either some or a great increase in ability to understand. All but one student also indicated that the training had improved their ability to study and absorb difficult material. Excluding factors besides the ability to read, 80 per cent of the students felt that the course had assisted them in taking examinations. Ninety per cent of the students felt they could concentrate better on their reading tasks.

There is one important point to keep in mind when examining the value of training individuals to improve their basic reading skills. The basic skills which a reading improvement course develops apply regardless of the material or the purpose for which it is read. As long as the reader is in a field with which he is familiar, he should be able to read with a maximum of speed and accuracy. If he invades a new field of knowledge, he need not learn to read. He needs to learn a new subject. Once he has learned and acquird sufficient background, the basic skills of reading should be put to use.

The Army reading improvement program is recognized as a means of meeting the need for developing better readers. Reading improvement training in our service schools serves as a worthwhile and practical means of developing skills which in varying measure assist our officers in becoming better students, more efficient administrators in some fields, and without doubt, better informed military leaders.

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NEW LOOK

(Continued from Page 7)

costs, keep less of the arsenal's money tied up in idle materials, and expose fewer items to the risk of becoming obsolete or unusable through deterioration.

To attain these ends, an improved materials management system has been instituted, which provides:

1. An up-to-date catalogue for use by post personnel, allowing selective substitutions. The first few months of its use indicate it may save about $60,000 a year.
2. Placement of dollar limitations on the stockage of items in using departments, based on realistic use expectancy.
3. Continuous screening of items to determine frequency of use to weed out or reduce inventories of slow-moving items.
4. Segregation of items that do not move, for channeling to other government agencies having a need for them.

These and many other forward steps show that the Army Industrial Fund system can be a wide-open avenue toward the goals of better management and greater efficiency, but the system itself is not a cure-all. It merely provides information upon which intelligent decisions can be based and does not, in itself guarantee that these decisions will be correct.

After all, it is not much different from the system used by industry—if a firm does not make money, its management officials are soon hunting for new jobs. At the present time the Chemical Corps has an on-the-job training program in operation, and is selecting officers who possess outstanding ability for business management courses at some of the nation's leading universities. Thus the right men can, and will, be selected for our top management jobs and they in turn will create more effective use of the Industrial Fund program.

However, the Army Industrial Fund offers no remedy—although in some cases it acts as a palliative—for difficulties originating outside the installation, such as shortages, inflation, delays in deliveries of materials, and changes in customers' programs. Its critics also say the system has been slow in building and application, is somewhat costly to install, and requires a type of accounting specialist not commonly found in government.

On this latter point, however, there is evidence that the program will attract new talent and know-how from private industry. Commercial type accountants, thoroughly schooled in the atmosphere of dollar-minded practicability of the business world, could exert a healthy influence in the costly years of armed readiness that lie ahead.

One sidelight on the operation of the Army Industrial Fund at Rocky Mountain Arsenal has been to foster a clearer perspective of the Army's "cost-consciousness" program.

During the first 18 months of the Industrial Fund's operation at Rocky Mountain we have been fortunate in having Colonel Crawford M. ("Jerry") Kellogg* in charge of operations. Being a wily Scotsman, Colonel Kellogg took to the Industrial Fund like a duck takes to water. He closed out his 34-year Army career by bringing into play all of the canny thriftiness attributed to his ancestral home.

For instance, the last time I visited Rocky Mountain I was not assigned a car and driver for my own use. Instead, I had to "hitch-hike" rides from one part of the post to the other. Said Colonel Kellogg, "After all, the gasoline for the car and the wages for the driver would have to be charged to the project and would result in an increased price for the end item." So I accepted rides from people going where I wanted to go—and liked it.

During this same visit, I noticed that the buildings used for visitors to the post were of the World War II barracks type. I pointed out to Colonel Kellogg that the success of the Industrial Fund was drawing so much attention that he could expect a number of VIP (Very Important People) visitors and that it might be well if he fixed up more suitable quarters for these people. My suggestion met with a violent objection—"the cost would have to be reflected in the items now under production, and the final price would have to be increased."

So, I offer a word of warning to anyone visiting one of our installations where the Army Industrial Fund has been out into operation: Don't look forward to any special attention or "plush carpet" treatment that costs anything, without expecting strong objections from the people charged with watching the funding program.

In all, however, the Army Industrial Fund has already shown that it can help obtain more defense for fewer dollars, and all this with no sacrifice of military effectiveness.

*Colonel Kellogg retired after 34 years of service on November 30, 1952.

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CHIEF CHEMICAL OFFICER MEETS MEN FORMERLY IN HIS COMMAND IN THE 2ND CHEMICAL MORTAR BATTALION

U.S. Army Photo by Pfc. Joseph Paeglow

WITH X CORPS, US ARMY IN KOREA—Maj. Gen. E. F. Bullene, Chief Chemical Officer of the Department of the Army, (left foreground) chats with (left to right) M/Sgt. Eugene Bevelacque, Jefferson, Pa. and M/Sgt. Barney B. Lazar, Corona, N. Y. both of whom served with him when he commanded the 2nd Chemical Mortar Battalion prior to World War II. Sgt. Lazar is first sergent of headquarters company and Sgt. Bevelacque is battalion motor sergeant of the mortar battalion on the Korean mountain front.

Major General E. F. Bullene, Chief Chemical Officer (left) pins the Bronze Star Metal on Lieutenant Colonel Robert K. Nelson as Mrs. Nelson looks on. The award was made for Colonel Nelson's services as Supply Control Officer and Operations and Training Officer in the Chemical Section, General Headquarters, Far East Command, from 20 October 1950 to 31 December 1951. Colonel Nelson is now assigned to the staff of the Comptroller, Office of the Chief Chemical Officer, Washington, D. C.

21ST DECON COMPANY GETS COMMENDATION CITATION

Another Army Chemical Corps unit, this time the 21st Chemical Decontamination Company, has received kudos for exceptional service in Korea.

The 21st received training at the Army Chemical Center, leaving for the Far East in August of 1950. The unit had two commanding officers during the period covered by the citation, first Capt. John William Searcy and later Capt. Raymond R. Treadway.

Eighth Army General Order 418 cites the Company "for exceptionally meritorious conduct in the performance of outstanding services in support of combat operations in Korea during the period 1 January to 30 June 1952." The citation further states:

"The primary mission of this company was decontamination and its members, through their diligence and matchless technical proficiency, consistently carried out their exacting tasks in a manner which elicited the highest possible praise from all those cognizant of their fine work. In addition, numerous tests of experimental equipment were made with great efficiency, shower facilities were provided for hundreds of thousands of United Nations personnel, vast quanities of napalm were supplied, thousands of flame throwers were serviced, and similar quantities of land mines were made available to combat units. Despite the rapid turnover in this unit's personnel and the frequent forward displacements made by the company, its high standard of excellence did not vary. The performance of its vital mission was such as to be worthy of the closest emulation in all future campaigns. The 21st CHEMICAL DECONTAMINATION COMPANY displayed such outstanding devotion to duty in the performance of exceptionally difficult tasks as to set it apart and above other units having similar missions. The unsurpassed ability, singleness of purpose, and esprit de corps exhibited by the members of this company reflect great credit on themselves and the military service of the United States."

4.2 IN KOREA

(Continued from Page 29)

tion centers, communications and ammunition resupply. Occasionally we perform the security missions for an infantry mortar platoon and once we manned their mortars for them. It is interesting that we are able to keep eight mortars per company in action with present-for-duty strengths averaging less than 80 enlisted men per company. The infantry companies usually run 120 to 155 enlisted men and only attempt to keep five or six mortars in action.

We are getting along all right in spite of personnel shortages and the bitter cold. We do not know what the Army has planned to do, but in spite of the long, hard and bitter retreat, morale is high.

We have very little left of headquarters company as I have transferred every possible man to the mortar companies. The personnel section and most of the motor section are kept well to the rear, while I operate the forward command post with three other officers and eighteen enlisted men. It is amazing how much can be done by so few people, but it is quite difficult and the strain is beginning to tell. I rotate both officers and enlisted men as much as possible. A couple of weeks eating and sleeping back in our rear echelon restores a man a great deal.

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DECORATION FOR KOREA VET

Maj. Gen. E. F. Bullene, Army Chief Chemical Officer, recently presented the First Oak Leaf Cluster for the Purple Heart to Capt. William T. Lipscomb, a native of Dahlonega, Ga. The presentation was made in the office of the Chief Chemical Officer at Gravelly Point, Washington, D. C., where Lipscomb is now assigned.

The award was made for wounds which Capt. Lipscomb received near Unsan, Korea on the night of 2 November 1950. At that time, he was Executive Officer of Company A, 2nd Chemical Mortar Battalion. This unit operated the 4.2 Chemical Mortar, a weapon which became famous in World War II and has played an important role in the heavy fighting in Korea.

Capt. Lipscomb (then a First Lieutenant) was wounded twice in this engagement—once in the right shoulder and later in the right forearm—and was hospitalized for about 13 months afterward.

A graduate of Dahlonega High School, Lipscomb attended North Georgia College and entered the Army in 1948.

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THE HISTORICAL CORNER

By BROOKS E. KLEBER*

Beginning with this issue the Historical Office of the Chief Chemical Officer will contribute a column to the *Armed Forces Chemical Journal*. The Historical Office feels that this contribution, which we hope will become a regular feature, will benefit itself as well as many of the Journal's readers. This, the first column, will begin with an explanation of the nature of the project.

The first part of the column consists of Historical incidents or anecdotes, the by-products of research, which will be of general interest to the readers of the *Journal*. A spectacular mortar mission, the heroism of a Chemical Corps soldier, an unusual accomplishment of a Chemical Corps unit—these could be the kinds of incidents included.

These columns will cover many of the activities of the Chemical Corps and thus, to some, will be informative. To others they will be nostalgic, recalling the friends and assignments of the years of active duty.

The column concludes with a question in some way related to the preceding narrative. It is the hope of the Historical Office that someone, be he an ex-mortarman or an ex-division chemical officer, will have the answers to the questions presented.

One of the important sources of historical information is that of the personal interview. For talking to people who have had intimate knowledge of the development of a certain Chemical Corps item or with the operational employment of a smoke generator unit often discloses valuable information which otherwise may never be revealed. This information may be some important point which somehow missed being recorded or it may be a personal observation or anecdote which did not fit into the sometimes impersonal format of an official report.

It is the purpose of this column to broaden the scope of the interviewing process so as to include all the readers of the *Armed Forces Chemical Journal*.

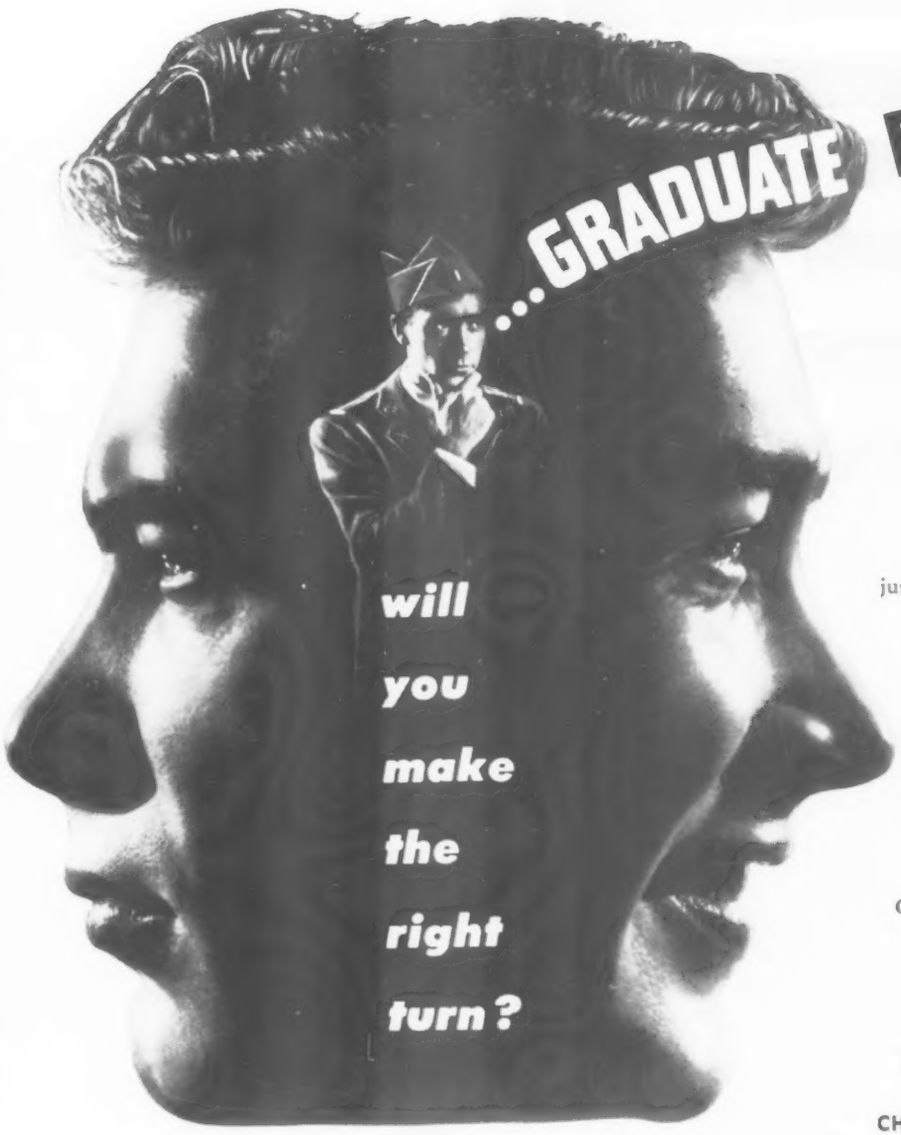
This, then, is the benefit which the Historical Office will derive from the column. Any communications may be sent to Brooks E. Kleber, Historical Office, OC Cml O, Army Chemical Center, Md. We earnestly invite your support.

THE BACKWARD MORTARS

One of the most violent battles of World War II took place on the Rapido River in Italy. In this action the 34th Infantry Division crossed the river in the vicinity of Cassino. The supporting American armor was halted at the river by effective German anti-tank fire. Smoke was needed at the crossing site, and the infantry was told to provide it. Across the river a resourceful, if daring, lieutenant faced his 81mm mortars to the rear and fired WP shell. Cloaked in the smoke the tanks got across.

There is no other case, in the files of the Historical Office, where smoke was fired back upon the supported troops. In fact, we are thinking of offering a reward to anyone finding in a field manual any reference to this method of laying smoke. Do any of the readers recall a similar example?

*Member of the Staff, Historical Office, Office of the Chief Chemical Officer.



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